DECEMBER, 1954

Traffic Engineering

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- Recent Speed and Delay Instruments
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Traffic Engineering

OFFICIAL PUBLICATION OF THE INSTITUTE OF TRAFFIC ENGINEERS

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COVER: This splendid view of Manhattan Island (New York City) in the vicinity of 180th Street was taken recently from near the top of the west tower at the New Jersey end of the George Washington Bridge, whose 8 lanes were under observation of a special time-motion movie camera (insert on left) in the research on urban congestion which is being conducted. The two center lanes are reversible to give 3 inbound — 5 outbound for P.M. peaks, or 5 in — 3 out for mornings. The ship is moving down the Hudson River toward the harbor. Apartment buildings atop the cliff tower above north-bound lanes (visible halfway up cliff right and left) and southbound lanes (lowest highway on right) of the Henry Hudson Parkway, as well as the New York Central railroad near water's edge at left). The latter enters a tunnel near the bridge.

DEFINITION: Traffic Engineering is that phase of engineering which deals with the planning and geometric design of streets, highways, and abutting lands, and with traffic operation thereon, as their use is related to the safe, convenient, and economic transportation of persons and goods.

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Obituary

THEODORE MALVIN MATSON

This page was set up with a Frankly Speaking editorial ready to be put on the printing press when word came of the sudden passing of our well loved Vice-President, Ted Matson, at the New Haven Hospital, Wednesday evening, December 15th. We profoundly regret the necessity of usurping this page to bring you such sad news.

Theodore Malvin Matson, Director of the Bureau of Highway Traffic at Yale University, an internationally known author in the field of highway traffic, was born in Denver, Colorado March 17, 1903. Entering Stanford University in 1919 he earned a Bachelor's degree in Chemical Engineering in 1923 and a Master's degree in Electrical Engineering in 1925. In 1926 he was employed as Chief Resident Engineer of the San Francisco Survey Commission and engaged in a traffic survey of San Francisco then being conducted with assistance of Dr. Miller McClintock of the Erskine Bureau for Street Traffic Research, Harvard University. Following completion of this engagement in 1929 he directed a traffic survey for the City of Kansas City, Missouri. He was Traffic Engineer of the City of Philadelphia from 1933 to 1935. He then joined the faculty of Harvard University with the Bureau for Street Traffic Research. When the Bureau moved to New Haven in 1938 Mr. Matson became a member of the Yale University faculty. He was appointed Director of the Bureau of Highway Traffic in 1943.

He was a pioneer in the development and establishment of the profession of traffic engineering, being one of the founders of the Institute of Traffic Engineers of which he was Vice-President at the time of his death. Previously, he had served a term as Director in 1939-41 and again in 1951-53. He served one term as Secretary-Treasurer prior to being elected Vice-President this year. He was long active on many of the Institute's Committees in both technical and administrative work.

Throughout his long career he was a leader in the formation of national traffic policies and has been responsible for the initiation of numerous research activities in the field. His leadership in the training of traffic engineers who are employed throughout the country in traffic work has been a major influence in the development of better highway transportation facilities.

Mr. Matson was a Consultant to the War Department in World War II. He was Parking Committee Chairman of the Highway Research Board of the National Research Council, and a Consultant to the Eno Foundation for Highway Traffic Control at Saugatuck, Connecticut. He was a member of the President's Highway Safety Conference. In addition to being a charter member of the Institute of Traffic Engineers he was also a member of the Society of Sigma Xi, the Society of Automotive Engineers, the American Society of Planning Officials and the American Public Works Association. Active in community affairs he was affiliated with the Graduates Club, Faculty Club, Kiwanis Club and High Lane Club, all of New Haven, and the Yale Club of New York City.

Surviving are his widow, the former Naomi Robinson; a daughter, Mary Jane, both of New Haven; and a sister, Mrs. Herbert Calderwood, Sterling, Colorado.

Two days before his death Ted put into the Editor's hands his editorial for the Frankly Speaking page of the January issue. Probably the last formal paper he prepared, it bespeaks his chief professional goal in life, the further advancement of a profession whose foundations he helped lay. What better way could his friends honor the memory of this great advocate of the science we profess than by the establishment of a Theodore Matson Memorial Fund for the advancement of traffic engineering knowledge, in the form of a scholarship, or annual award or perhaps a research project. A memorial fund is now being organized by the Institute's Executive Secretary, acting as a temporary trustee.

FRANKLY SPEAKING

THE IMPORTANCE OF BASIC RESEARCH

Generally speaking, our profession recognizes that basic research is important. We recognize, for example, the importance of basic research which preceded atomic fission and its practical control. That rich dividends grow out of fundamental research is accepted almost as axiomatic today.

Yet, traffic officials and others concerned with the improvement of highway transportation have not seriously promoted fundamental research into traffic phenomena. The urgent pressures of daily problems have not permitted, up to this time, the necessary proportionate share of intellectual curiosity about the fundamental nature of traffic movement. Applied programs, based on practical studies, have crowded out the fundamental exploration and research which should precede the practical development. But these policies prevent the realization of the rich dividends produced from investment in pure research.

It is only through basic research that the complexities of traffic movement can be reduced to their simplest elements. It is only out of these component elements of traffic movement, that the complex of traffic congestion and accidents is fabricated. Clearly then, if we can gain a fuller understanding of the simplest elements of traffic motion, we can compound these traffic elements into practical working schemes, and make accurate predictions about traffic performance with such schemes.

For example, it is generally recognized that intersections are a primary key factor in accident and congestion causation. Yet, regardless of the complexity of intersection geometry and plans of intersection control, it is generally seen that all intersection and interchange operations are made up of only three elementary traffic maneuvers, that is to say, all intersection operations are compounded from elementary merging, crossing, and diverging maneuvers. But our understanding, with any degree of accuracy, of these elementary maneuvers is indeed very limited. Thus we know little about, let us say, a right turn maneuver and the time space relationship involved in the merging and diverging operation out of which this maneuver is formed. This holds true for the simplest urban intersection, let alone the comparable maneuver of a high speed modern interchange.

Until traffic movements are reduced to their simplest terms through analysis of their component parts, until the inter-relationship of time and space in the traffic stream is understood, and until the disciplines of thought about traffic are made rigid even to a mathematical degree, traffic engineering will remain more of an art than a science.

Admittedly broad, bold thinking and concepts are required in facing the traffic problems before us today, but the implementation of these broad concepts can be efficiently carried out only if it is based on fundamental research. Regardless of how much we may profess our knowledge and abilities as engineers; unless we attend the necessary detail required to satisfy intellectual curiosity about basic traffic phenomenon, and unless we encourage and carry forward the frontiers of pure research into traffic matters, our profession cannot keep pace with its responsibilities nor will it achieve its rightful place among the diverse branches of engineering.

Theodore M. Matson

VICE PRESIDENT

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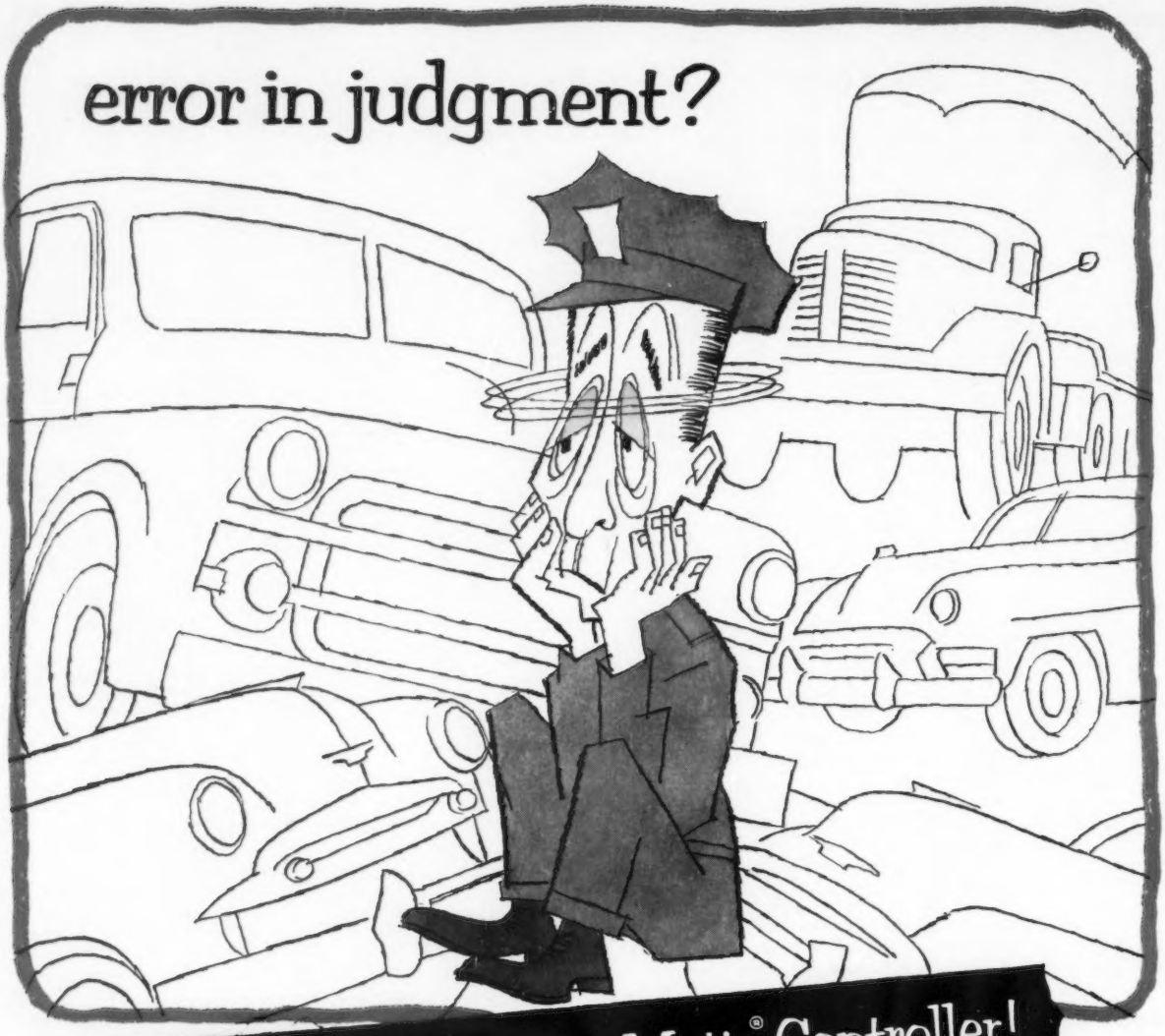

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A Comparison of Three Methods for Measuring Delay at Intersections

By Donald S. Berry (Mem., ITE)
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University of California, Berkeley, California

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This paper was presented at the California Street and Highway Conference meeting in February, 1954. It was first published in the "Proceedings" for that meeting. We are indebted to both Proceedings editors and the authors for permission to republish this article.—EDITOR.

THIS STUDY OF METHODS for evaluating delay at signalized intersections is one part of a more extensive study which is being conducted at the University of California for the purpose of comparing the effect of signal control on intersection delay.

The purpose of this phase of the study is to compare results obtained by the following three methods of measuring intersection delays: (1) the ITTE delay meter; (2) the sampling method; and (3) the spaced serial photo method.

Very little information has been published on methods for measuring delay to vehicles at intersections, although it is known that most of the delay in urban areas occurs because of conflicting movements at intersections. A simple and reliable method for measuring intersection delay could be very helpful in comparing the efficiency of different types and timings of traffic signals.

At the outset, however, it should be pointed out that delay is only one of several factors to be considered in evaluating the efficiency or effectiveness of traffic controls at an intersection. Other factors include the following:

1. Motorist's desires; the motorist may prefer one type of control over another even though the delay is greater. For example, the motorist usually prefers the certainty of right-of-way granted by a signal over the nervous tension of entering past a stop sign, even though the average delay may be much greater at the signal.

2. Comparative accident experience resulting with the different types of traffic control.

3. Cost of operation, including costs of vehicle operation, under the different types of traffic control.

Definitions of Delay

Delays to vehicles in traversing intersections have been subdivided into the following types for purposes of this study.

1. *Travel-time delay*—This type of delay for an individual vehicle is the difference between its actual time required to traverse some fixed distance at the approach to an intersection, and the travel time which would have been required had the vehicle been able to continue at the average speed of approaching traffic.

2. *Average travel-time delay*—The average of travel-time delays for all vehicles approaching during the period of time.

3. *Stopped-time delay*—The time an individual vehicle is standing still while waiting in line in the approach to a signalized intersection.

4. *Average stopped-time delay*—The average of stopped-time delays for all vehicles approaching during the period of time.

5. *"Unnecessary" stopped-time delay*—That portion of the stopped-time delay which occurs when there is no vehicle entering or approaching on the opposing legs of the intersection.

6. *Percent stopped*—The ratio of the number of vehicles which come to a stop in approaching an intersection, to the total number entering in the same period of time, expressed as a percentage.

The average travel-time delay appears to be the type of delay which would have the greatest significance in comparing the effectiveness of different traffic control devices. This type of delay is about the only type which can be used to compare delay under the signal vs. stop-sign control.[1]

Stopped-time delay, however, is much easier to measure than travel-time delay. Thus, a primary purpose of this investigation is to determine the correlation between stopped-time delay and travel-time delay.

Methods for Measuring Delay

Eight different methods (including methods Nos. 1 and 3, below) for measuring intersection delay were presented and discussed in an earlier report by Edward M. Hall.[1] The three methods which are compared in the current study are described briefly below.

1. *The ITTE delay meter.* This device consists of electrically-operated counters which add vehicle-seconds of stopped time at rates which are directly proportional to the number of vehicles which are standing at any instant. The meter is operated by keeping two rotary switches or handles adjusted to the position corresponding to the number of cars standing and waiting to resume motion. When the handle is set for one stopped vehicle, the counter adds one vehicle-second per second. When the handles are set for 32 stopped vehicles, 32 vehicle-seconds of stopped time are added per second. One counter also accumulates the number of stopped vehicles.

*Mr. Van Til was with the staff of the Institute of Transportation and Traffic Engineering, as Junior Engineer, when he participated in this study.

Fig. 1
ITTE delay meter. Early model (left) used two rotating switches; later model (right) only one.

The ITTE delay meter is based upon the principle used in the Automatic Signal Division Meter described by Hall.[1] Two rotating switches were used, one for stopped vehicles numbering from 1 to 9, and the other for vehicles in groups of 10 (10, 20, 30, 40, etc.). A later model, now in use, has only one rotary switch, and thus is simpler to operate. The two meters are shown in Fig. 1.

The total number of vehicles entering the intersection during a time interval (usually 15 min.) is obtained manually in order to permit the determination of average stopped-time delay per vehicle entering the intersection.

2. *The sampling method.* This method for estimating vehicle-seconds of stopped time requires, for each approach, an observer, a stop watch, and paper and pencil. At periodic intervals (every 15 to 20 sec.), the observer determines the number of cars stopped in the approach to the intersection, and records the number of stopped cars corresponding to the exact time of the observation. Total vehicle-seconds of delay for a 15-min. period is determined by adding the total of all of the periodic observations and multiplying by the time interval between observations, in seconds. The method is an adaptation of the ratio-delay method used in industrial engineering.[2]

When sampling at a location with fixed-time signal control, the time interval between observations is selected so that repetitive sampling in the same parts of the signal cycle is avoided. The total number of vehicles entering the intersection during the 15-min. period is determined manually.

3. *The spaced serial photo method.* Spaced serial photos have been used in obtaining vehicle speeds on freeways[3] and in studying conflicting movements at intersections[4, 5] and in weaving sections[6]. Adaptation of spaced serial photos to studies of intersection delay by the ITTE has recently been described by Van Til.[7]

The equipment consists of a 16 mm. gun-camera which can be electrically operated to take pictures at intervals of ½, 1, or 2 sec. In one corner of each picture, there is a serial number corresponding to the time the picture was taken. The camera is mounted in an elevated position at a point where it is possible to include in the picture several hundred feet of roadway in one approach to an intersection, as shown in Fig. 2.

After pictures are taken and developed, the film is analyzed with the aid of a special projector which permits the film to be moved forward or backward, frame by frame. The travel time and the stopped times for each vehicle are obtained, along with total traffic volume. Data are summarized by 15-min. periods, as with the other methods.

Collection of Data

Data were collected by the three methods simultaneously, at approaches to two intersections controlled by three-phase traffic signal controllers. Locations and times of data collection are as follows:

1. Intersection of San Jose Avenue and Monterey and Diamond Streets, San Francisco (Southbound on San Jose Avenue), September 3 and November 20, 1953.

2. Intersection of Eastshore Highway and Carlson Boulevard, Richmond (Northbound on Eastshore Highway), August 6, and October 16, 1953.

Manual counts of total entering volumes and of the number stopping were made for each studied approach and summarized by 15-min. periods. The ITTE delay meter was used to provide the total number of vehicle-seconds of stopped time for each 15-min. period and the number of vehicles stopping. The sampling method yielded vehicle-seconds of stopped time. The spaced serial photos provided data on entering volume, number stopping, vehicle-seconds of stopped time, and the travel time for each vehicle in tra-

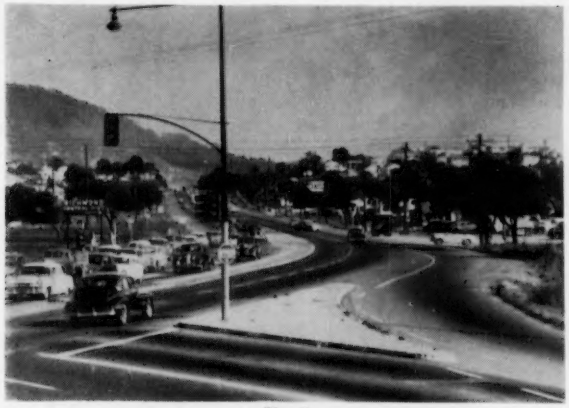

Fig. 2
Intersection of Eastshore Highway and Carlson Boulevard, showing several hundred feet of the southern approach of Eastshore Highway, as seen from the camera mount.

versing the last several hundred feet in advance of the intersection.

Altogether, 21 separate 15-min. periods of data were obtained at the two intersection approaches. A summary of this data is given in Table 1. Information on the timing of the signals is also given.

Analysis of Data

Travel-time delay vs. stopped-time delay. One of the primary purposes of this investigation was to determine whether measurements of stopped-time delay would give results comparable to those by measurement of travel-time delay. The data obtained by the spaced serial photo method permitted such a comparison to be made.

Fig. 3 shows the distribution of travel times for vehicles travelling southbound on San Jose Avenue from the advance checkpoint to the stop line at the intersection with Diamond and Monterey, for one hour between 2:15 and 3:15 P.M., November 20, 1953. Also shown are the distribution of individual travel times for the vehicles which stopped, as obtained with the camera, and the travel times for those vehicles which did not stop.

A total of 735 vehicles were timed by the camera during this hour, with 62% of this number being required to come to a stop.

The average travel time for vehicles which did not stop was much lower than the average for the stopped vehicles (22.6 sec. vs. 48.7 sec.). The average travel time for all vehicles was 38.8 sec. The distribution curve for stopped-vehicle travel times has more dispersion than does the peaked curve for the non-stopping vehicles.

The data on travel times for vehicles which did not stop was used in determining an average travel time during which vehicles theoretically could have traversed the distance had there been no delay. Fig. 4 shows the distribution of these travel times on San Jose for two different hourly periods of time. Average travel times, and travel times corresponding to the lower limit of the fastest third of the vehicles, are shown on the distribution curves. Some of the non-stopping vehicles undoubtedly were delayed by the stopped vehicles ahead of them. The lower limit of the fastest third is thus probably more representative of the average travel time for the "no delay" condition than is the mean time for all non-stopping vehicles.

Similar data on travel times for non-stopping vehicles on Eastshore Highway, during peak and non-peak conditions, are shown in Fig. 5. A travel time of 34.24 sec. for the non-peak condition corresponds to an average over-all speed of 37.9 mph, whereas 41.95 sec. for the peak-hour condition corresponds to a speed of 30.9 mph. The highway is zoned for 35 mph. The travel time for the lower limit of the fastest third of the vehicles was taken in each case as the value for "theoretical" travel time under "no delay" conditions. This "theoretical" travel time then was subtracted from the average total travel time to give a value of average travel-time delay.

Fig. 6 shows the distributions of individual travel-time delays and stopped-time delays for the San Jose approach during the off-peak hour. The average stopped-time delay was 14.27 sec. per vehicle, which was 77.2% of the average travel-time delay of 18.48 secs. As a result of the definition of travel-time delay, some vehicles are shown as having negative travel-time delay. Travel-time delay for each vehicle was obtained by subtracting from each individual travel time a value representing an *average* value of travel time under "no delay" conditions. Vehicles under "no delay" conditions actually do not all travel at the same speed, but some travel faster and some slower than average. The distribution of travel-time delay would have had no negative values if travel-time delay had been defined as the difference between the actual travel time and the time that the *same* vehicle would have required had there been no intersection delay.

Stopped-time delay. The accumulated numbers of vehicle-seconds of stopped time, as obtained by each of the three methods, are compared in Tables 3, 4, and 5 for each of the 21 separate 15-min. periods. The Tables also show the percentages by which the delay meter and sampling method differ from results obtained with spaced serial photos.

The ITTE Delay Meter and the camera method were used at the Eastshore Highway intersection during 10 different 15-min. periods. The results obtained with the delay meter ranged from 13.3% higher than those of the camera method, to 22.9% less. When two or more 15-min. periods are grouped as shown in Tables 3 and 5, the average values for stopped time for the two methods do not deviate more than 6.2% for any of the three sets of grouped data.

The delay-meter results for the San Jose intersection on November 20 were all on the low side, due possibly in part to the fact that, because of an oversight, the batteries used for the test were new batteries which had not been processed for use. Stopped-time delay for the periods to 4:30 P.M. varied from 5.4 to 10.2% below corresponding values obtained by the camera method, but averaged to within 9% of the values obtained with the camera. Delay-meter results obtained at this intersection on September 3 yielded stopped times about 5% higher than the camera method, as shown in Table 5.

The visual sampling method consistently yielded results which, when grouped for similar volumes, were all within 6.4% of the values obtained by the camera method at these two intersection approaches.

These data indicate that both the delay-meter and the sampling method can be used to give reasonably consistent values of accumulated stopped-time delay under the conditions existing at these high-volume approaches. Frequently, during the peak hour, as many as 50 vehicles were waiting at one time, which required considerable dexterity on the part of the operator of the delay meter.

The sampling method gave unreliable results at an intersection with two-phase fixed-time signals when the cycle

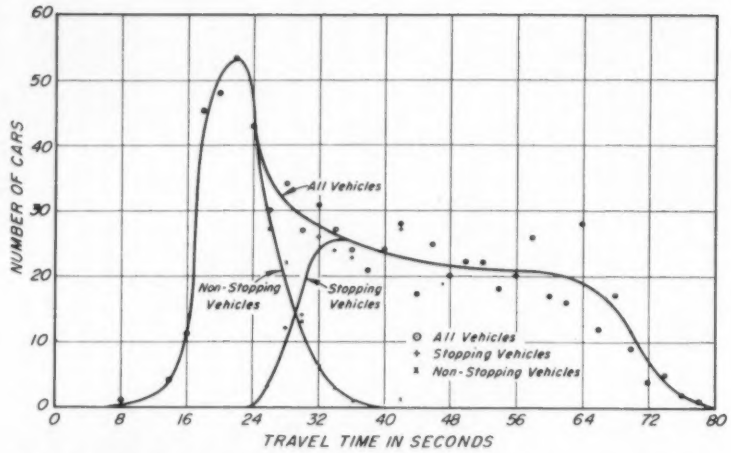

Fig. 3 - Distribution of vehicle travel times on San Jose Ave., during the off-peak period (2:15 - 3:15 p.m.) on Nov. 20, 1953.

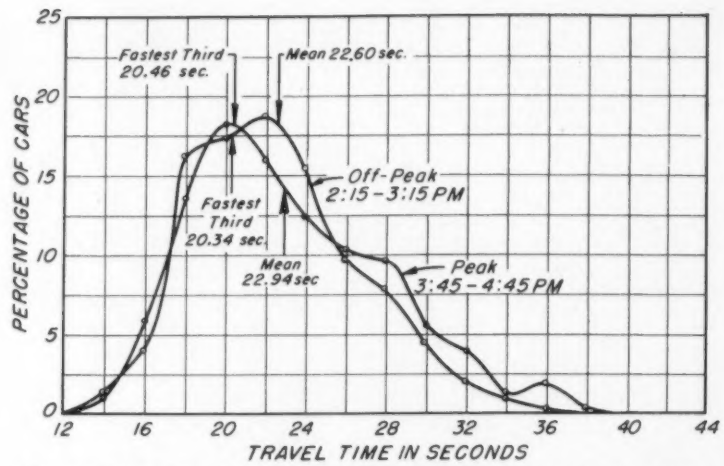

Fig. 4 - Distribution of travel times of non-stopping cars on San Jose Ave. (Nov. 20, 1953) for two different hourly periods of time.

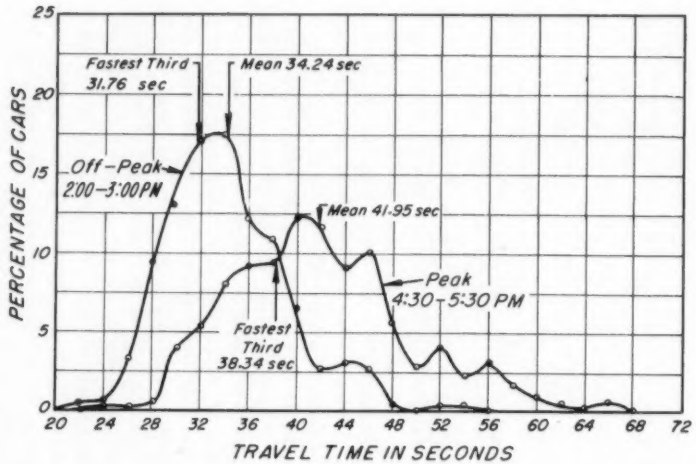

Fig. 5 - Distribution of travel times of non-stopping cars northbound on Eastshore Highway approaching Carlson Blvd. (travel distance 0.36 miles) on Oct. 16, 1953.

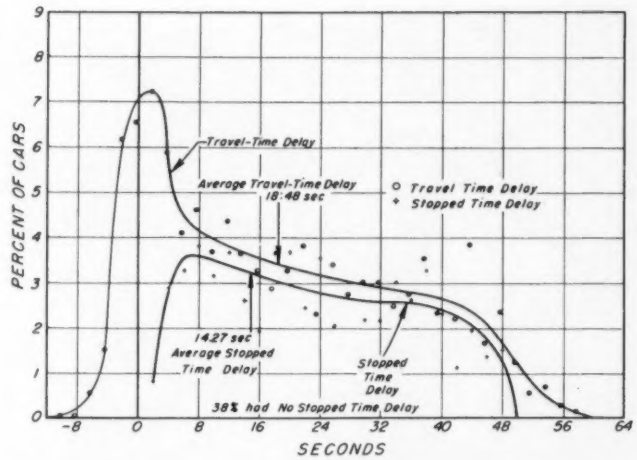

Fig. 6 - Distribution of travel-time and stopped-time delays on San Jose Ave. during the off-peak period on Nov. 20, 1953.

length was a multiple of the sampling frequency, and the length of the red light was relatively short. This pointed out the need for care in selecting the time interval for sampling.

Table 2 shows the comparison of the resulting average travel-time delay and the average stopped-time delay for sixteen 15-min. periods at the two intersections. The travel-time delay (column 6) is obtained by subtracting the "theoretical" travel time (column 5) from the actual travel time (column 4). Column 8 has percentage figures, which show average stopped-time delays as a per cent of average travel-time delay. The percentages at the San Jose approach are above 70% in every case. Average stopped-time delay at the Eastshore approach varies from 54% of average travel-time delay during non-peak hours, to 80% during the peak-hour conditions.

Results at these two intersections indicate that for the conditions of approach speeds and signal timing, the measurements of stopped-time delay provide a method for evaluating a substantial portion of the total delay. The portion of the total delay which is evaluated by stopped-time measursements is also the variable portion which is related to changes in the timing of the signals.

Volume Counts. Some variation is apparent in the values

TABLE 1—SUMMARY OF DELAY DATA OBTAINED BY THREE METHODS

	Traffic Volume		Number Stopped		Total Stopped Time, P.M., seconds		
	By Camera	By Manual Count[d]	By Camera	By Meter	By Camera	By Meter	By Sampling
Eastshore Highway,[a] October 16, 1953:							
2:00-2:15	152	153	40	42	805	702	720
2:15-2:30	162	167	37	49	689	781	690
2:45-3:00	173	172	68	73	1103	1184	1020
TOTAL	487	492	145	164	2597	2667	2430
4:30-4:45	335	349	142	170	3089	3144	2730
4:45-5:00	347	345	136	119	3005	2315	2100
5:00-5:15	340	353	143	169	4139	4162	4440
5:15-5:30	329	330	188	202	5647	5396	5865
TOTAL	1351	1377	609	660	15,880	15,017	15,135
San Jose Avenue,[b] November 20, 1953:							
2:15-2:30	172	195	97	100	2376	2121	2490
2:30-2:45	199	185	128	133	2642	2401	2670
2:45-3:00	183	183	113	116	2668	2459	2685
3:00-3:15	181	184	116	117	2878	2641	2685
TOTAL	735	747	454	466	10,564	9622	10,530
3:30-3:45	223	232	133	139	3166	2927	3285
3:45-4:00	248	268	159	170	3774	3572	3705
TOTAL	471	500	292	309	6940	6499	6990
4:15-4:30	297	318	197	208	4956	—	4785
4:30-4:45	450	497	364	385	10,170	—	9525
4:45-5:00	461	490	274	260	7524	—	6705
TOTAL	1208	1305	835	853	22,650	—	21,015
Eastshore Highway,[a] August 6, 1953:							
2:30-2:45	155	157	66	82	956	1033	—
3:45-4:00	206	208	69	90	1101	1193	—
4:15-4:30	254	250	95	118	2401	2507	—
TOTAL	615	615	230	290	4458	4733	—
San Jose Avenue,[c] September 3, 1953:							
2:30-2:45	—	160	77	84	1286	1354	—
2:45-3:00	—	178	91	103	1388	1458	—
TOTAL	—	338	168	187	2674	2812	

a. Northbound on Eastshore Highway at Carlson Boulevard, Richmond. Controlled by three-phase traffic-actuated controller with skip-phase so that left-turn can move with northbound traffic when possible. During off-peak hours, cycle length averages about 78 sec., with northbound traffic facing red about 36% of time. For peak hour, these figures average 126 sec. and 32%.

b. Southbound on San Jose Avenue at Monterey and Diamond, San Francisco. Three-phase fixed-time control: 2:00-4:45 P.M., 80-sec. cycle, with 44-sec. red on San Jose. 4:45-5:30 P.M., 120-sec. cycle with 55.2 sec. red on San Jose.

c. Southbound on San Jose Avenue at Monterey and Diamond, San Francisco. Controlled by three-phase traffic-actuated controller with pedestrian timer. Between 2:30 P.M. and 3:00 P.M. the average cycle length was 51.4 sec., with southbound traffic facing red about 53% of time.

d. Average.

TABLE 2—STOPPED-TIME DELAY VS. TRAVEL-TIME DELAY FROM CAMERA STUDY AT TWO INTERSECTIONS

(1) Time, P.M.	(2) Volume Vehicles per hour	(3) Per cent Stopped	(4) Average Travel Time, Seconds	(5) Average "No Delay" Travel Time, Seconds	(6) Average Travel-Time Delay, Seconds	(7) Average Stopped-Time Delay, Delay, Seconds	(8) Average Stopped Delay as Per cent of (6)
Eastshore Highway October 16, 1953							
2:00-2:15	152	26.3	42.0	31.8	10.2	5.5	53.9
2:15-2:30	162	22.8	39.6	31.8	7.8	4.3	55.1
2:45-3:00	173	39.3	43.2	31.8	11.4	6.4	56.1
4:30-4:45	335	42.4	52.7	38.3	14.4	9.2	63.9
4:45-5:00	347	39.2	54.5	38.3	16.2	8.7	53.7
5:00-5:15	340	42.1	55.5	38.3	17.2	12.2	70.9
5:15-5:30	329	57.1	61.0	38.3	22.7	17.2	75.8
San Jose Avenue November 20, 1953							
2:15-2:30	172	56.4	38.1	20.4	17.7	13.8	78.0
2:30-2:45	199	64.3	38.1	20.4	17.7	13.3	75.1
2:45-3:00	183	61.7	38.9	20.4	18.5	14.6	78.9
3:00-3:15	181	64.1	40.4	20.4	20.0	15.9	79.5
3:30-3:45	223	59.6	37.9	20.4	17.5	14.2	81.1
3:45-4:00	248	64.1	40.5	20.4	20.1	15.2	75.6
4:15-4:30	297	66.3	41.5	20.4	21.1	16.7	79.1
4:30-4:45	450	80.9	49.6	20.4	29.2	22.6	77.4
4:45-5:00	461	59.4	42.1	20.6	21.5	16.3	75.8

TABLE 3—COMPARISON OF AVERAGE STOPPED-TIME DELAY BY THREE METHODS AT EASTSHORE HIGHWAY, OCTOBER 16, 1953

Time, P.M.	Camera Method Average Stopped-Time Delay, sec. per vehicle	Per cent of Differences from Camera Method By Delay Meter	By Sampling Meter
2:00-15	5.5	—12.8	—10.5
2:15-2:30	4.3	+ 13.3	+ 0.1
2:45-3:00	6.4	+ 7.3	— 7.5
45-Min. Total	5.4 sec.	+ 2.7%	— 6.4%
4:30-4:45	9.2	± 1.8	—11.6
4:45-5:00	8.7	—22.9	—30.1
5:00-5:15	12.2	+ 0.6	+ 7.3
5:15-5:30	17.2	— 4.4	+ 3.9
One-Hour Total	11.8 sec.	— 5.4%	— 4.7%

TABLE 4—COMPARISON OF AVERAGE STOPPED-TIME DELAY BY THREE METHODS AT SAN JOSE AVENUE, NOVEMBER 20, 1953

Time, P.M.	Camera Method Average Stopped-Time Delay, sec. per vehicle	Per cent of Differences from Camera Method By Delay Meter	By Sampling Method
2:15-2:30	13.8	—10.2	+ 4.8
2:30-2:45	13.3	— 9.1	+ 1.1
2:45-3:00	14.6	— 7.8	+ 0.6
3:00-3:15	15.9	— 8.2	— 6.7
One-Hour Total	14.4 sec.	— 8.9%	— 0.3%
3:30-3:45	14.2	— 7.5	+ 3.8
3:45-4:00	15.2	—5.4	— 1.8
Half-Hour Total	14.7 sec.	— 6.4	+ 0.7%
4:15-4:30	16.7		— 3.5
4:30-4:45	22.6		— 6.3
Half-Hour Total	20.2 sec.		— 5.4%
4:45-5:00	16.3		—10.9%

TABLE 5 — COMPARISON OF AVERAGE STOPPED-TIME DELAY BY DELAY-METER AND CAMERA METHODS

Location and Date	Time, P.M.	Camera Method Average Stopped-Time Delay in sec. per vehicle	Delay Meter Difference from Camera Method Per cent
Eastshore Highway	2:30-2:45	6.2	+ 8.1
8/6/53	3:45-4:00	5.3	+ 8.3
	4:15-4:30	9.5	+ 4.4
	45-Min. Total	7.2 sec.	+ 6.2
San Jose Avenue	2:30-2:45	8.0	+ 5.3
9/3/53	2:45-3:00	7.8	+ 5.0
	30-Min. Total	7.9 sec.	+ 5.2

obtained for 15-min. traffic volumes by manual counts and those obtained from the spaced serial photos, as shown in Table 1. When groups of two, three, or four 15-min. periods are combined, these differences tend to counteract each other, indicating either a certain randomness in the differences, or more likely, an indication that exact synchronization of recording times between the camera operator and the manual enumerator was not obtained. However, even in the figure for the combined periods, the manual counts are consistently somewhat higher than those obtained by the camera. This variation is the greatest for the high-volume 45-min. period between 4:15 and 5:00 P.M. on San Jose Avenue on November 20 where the value obtained by manual counting is about 8% higher than that obtained by the camera. Over the entire period, the manual volume counts are about 3½% higher than the counts obtained from the photographs.

Number Stopped. The delay meter is equipped with a counter which automatically totals the number of vehicles coming to a stop. When delay is high, some vehicles are "caught" by the signal a second time, and they are recorded twice as stopped vehicles.

The delay-meter values for the number of vehicles stopped are, in all except one 15-min. period, higher than the values obtained from the analysis of spaced serial photos, as shown in Table 1. When 15-min. periods are grouped, the average delay-meter value of the number stopping varies from 2% higher to a maximum of 26% higher; overall, the difference averages about 7%. In other tests made under conditions of high delay, it was apparent that the delay-meter value for the number of stopped vehicles was not reliable. In some instances the number of stopped vehicles totalled 150% of the total number of vehicles.

Manual counts of the number of non-stopping vehicles and the number stopping were found to be quite reliable. Such counts normally are made to supplement the sampling method of estimating stopped-time delay.

When the lengths of the cycle do not vary materially, the per cent of vehicles stopping (see Table 1) may be useful as one measure of delay. However, the vehicle-seconds of stopped time per vehicle provides a more realistic measure for all different types of signalized control, since this measure takes into account the length of time the vehicles must wait.

Conclusions and Recommendations

1. Measurements of stopped-time delay appear to provide a satisfactory basis for a comparison of vehicular delay under different types of control at signalized intersections.

2. Delay meters which accumulate vehicle-seconds of stopped time can give reliable results under conditions in which the number of vehicles accumulated at any time can be estimated with reasonable accuracy by the operator. One trained operator observing from an elevated position can normally keep account of the number of stopping vehicles as long as the number waiting usually does not exceed 50 vehicles at any one time.

3. The sampling method of determining stopped-time delay is simpler than the delay-meter technique and gives equally reliable results under the conditions tested. The time interval between observations must be selected to avoid repetitive sampling in the same parts of the signal cycle.

4. The spaced serial photo method can provide complete data on delay for one approach, but requires considerable time for reduction of data. This method is, however, well suited to comparing delays at signalized vs. non-signalized intersections.

5. More study should be given to such problems as:

a. The accuracy of the sampling method at two-phase signalized intersections where the length of the red interval is relatively short.

b. Techniques for operating the delay meter when the number of vehicles waiting for the green is large (50 to 100).

c. The relationships between delay and the percentage of vehicles stopped.

d. The relation between "unnecessary" stopped-time delay and total stopped-time delay under different conditions.

e. Techniques for using cameras in sampling to obtain number of stopped vehicles.

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Recent Speed and Delay Instruments

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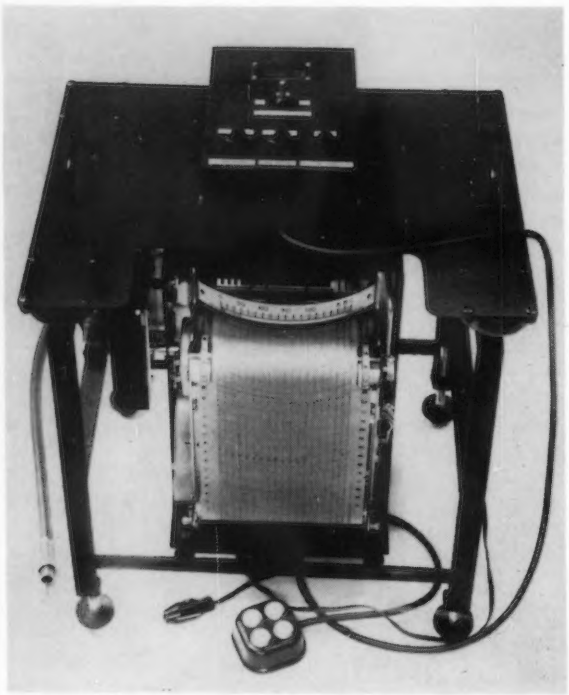


Fig. 1
First model of Recording Speedometer. Note shock absorbent frame, control box on top, coding buttons, gear box on left, speed trace on left side produced by distance used as constant.

SIGNIFICANT CONTRIBUTIONS made by traffic engineers in the past in solving traffic situations are but foreshadows of the events of the future. However, further professional development will necessitate greater reliance on facts than has been true in the past. The insatiable demands of increased automobile ownership force this regardless of what may be wished otherwise. The shift from reliance on skilled opinion to traffic decisions based on factual data will advance the already high esteem in which the traffic engineer is held.

Instruments are necessary in gathering many kinds of data and occasionally in presentation of such facts. It is a pecularity but true, that Americans are prone to adopt a worshipful air and stand somewhat in awe of machine-produced diagrams and data. Witness, for example, the success of the Radar Speed Meter. It has been said that the major value of the General Motors Proving Grounds was realized only after the development of instrumentation making possible precise comparative measurements.

Instruments, in order to be really useful to the traffic engineer, should have two basic principles. They must be simple, at least in operation if not in form, and should produce data in the form of charts, summarized figures, or readily understandable ratios easy to analyze and present.

With the exception of traffic counting devices and stop watches, very little instrumentation is in use today by traffic engineers. A few departments do use versatile Operation Recorders for certain studies but almost none, for example, have modified the movie camera to make time-motion records of particular traffic situations, despite the fact that this means of instrumentation has been known for 22 years. A concerted effort to do something about the urban congestion problem has undoubtedly given considerable impetus to the recent development of instruments designed to comparatively measure, for rating purposes, some of the elements contributing to congestion.

Recent interest in the realm of urban sufficiency rating development was evidenced by papers[1] presented by John W. Gibbons and Albert Proctor, and by Claude A. Rothrock on "Economic Cost of Traffic Congestion" and "Urban Congestion Index Principles" respectively, at the last meeting of the Highway Research Board. Techniques used in speed and delay studies, corresponding instrumenta-

[1] "Urban Traffic Congestion" — Bulletin No. 86, Highway Research Board, Washington, D. C., 1954.

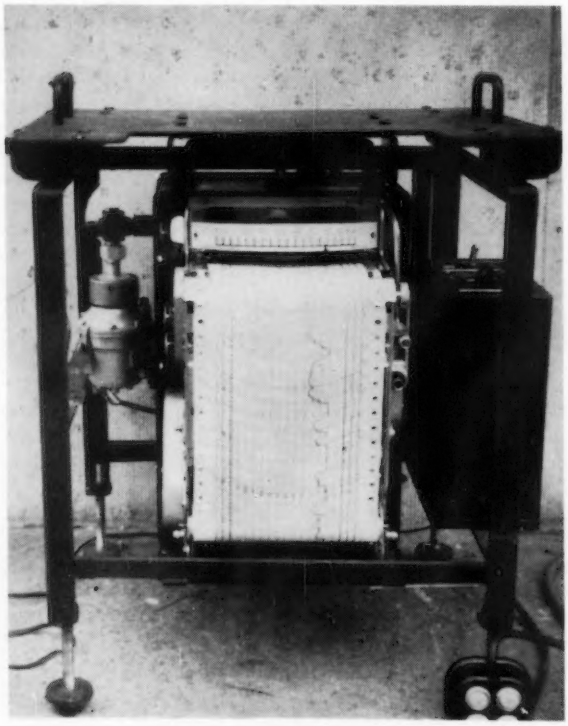


Fig. 2
Present model of Recording Speedometer. Time used as constant. Control box has been moved to right side, gear box not necessary with time as constant. Note time pen lines on left of paper, speed trace and code lines on the right. Extension speedometer cable fits voltage generator at left.

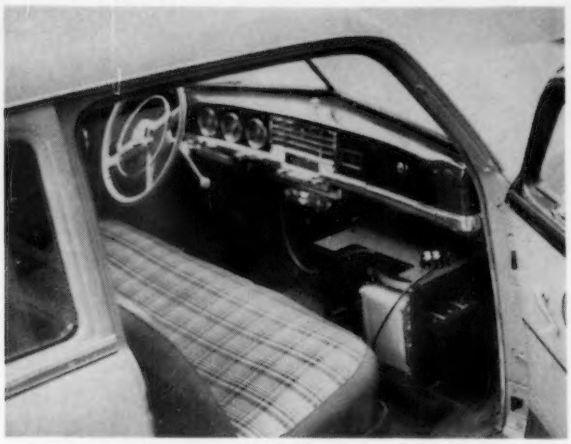


Fig. 3
Recording Speedometer placed in car for use. Note extension to speedometer and power supply to cigarette lighter socket. Legs adjust to floor board to keep paper and pens approximately level.

tion, and new techniques and instrumentation are being used to attack the urban congestion problem. The first step is finding and developing a sufficiency ratio which would be to urban traffic ways as highway sufficiency ratios are to rural roads. The establishment of such urban ratios and their use in eliminating congestion will fall upon the traffic engineer's shoulders.

Establishing and using these ratios will be simplified by the use of graphic recording instruments which give instantaneous records of speed and traffic conditions. A new instrument, the Recording Speedometer, has been developed expressly for this purpose. It greatly simplifies data collection and allows graphic presentation of speed (and delay) conditions existing.

Recording Speedometer

The Recording Speedometer, as its name implies, graphically records on chart paper the instantaneous speeds of a vehicle in motion. Thus, it gives a picture of the speed fluctuations encountered by a car driven in a traffic stream.

Figures 1 and 2 indicate the general make-up of the device. Essentially, it is built around an Esterline-Angus Operation Recorder, the recorder being a hybrid of the Radar Speed Meter recorder and 20 pen recorder. This recorder is mounted in a shock absorbent frame which has aircraft-type rubber shock mountings to minimize road and vehicle vibration.

An extension speedometer cable connects to the car speedometer by means of a "T" connection immediately in back of the speedometer dial housing. The extension cable is connected at the device end to a generator (shown on the left side of instrument). The cable, as it revolves, generates voltage which actuates the chronograph pen causing it to fluctuate directly as the speed varies, thus tracing on the chart the instantaneous speeds produced. The device has two pens (on the left side of the recorder) actuated by a highly accurate D. C. clock mechanism housed in the "box" on the right side of the frame. Time is recorded to one minute by one of these pens and to six seconds by the other by means of "blips". Three pens on the right side of the chart, actuated by push buttons, are for coding purposes. Room is provided for an additional pen if desired. A con-

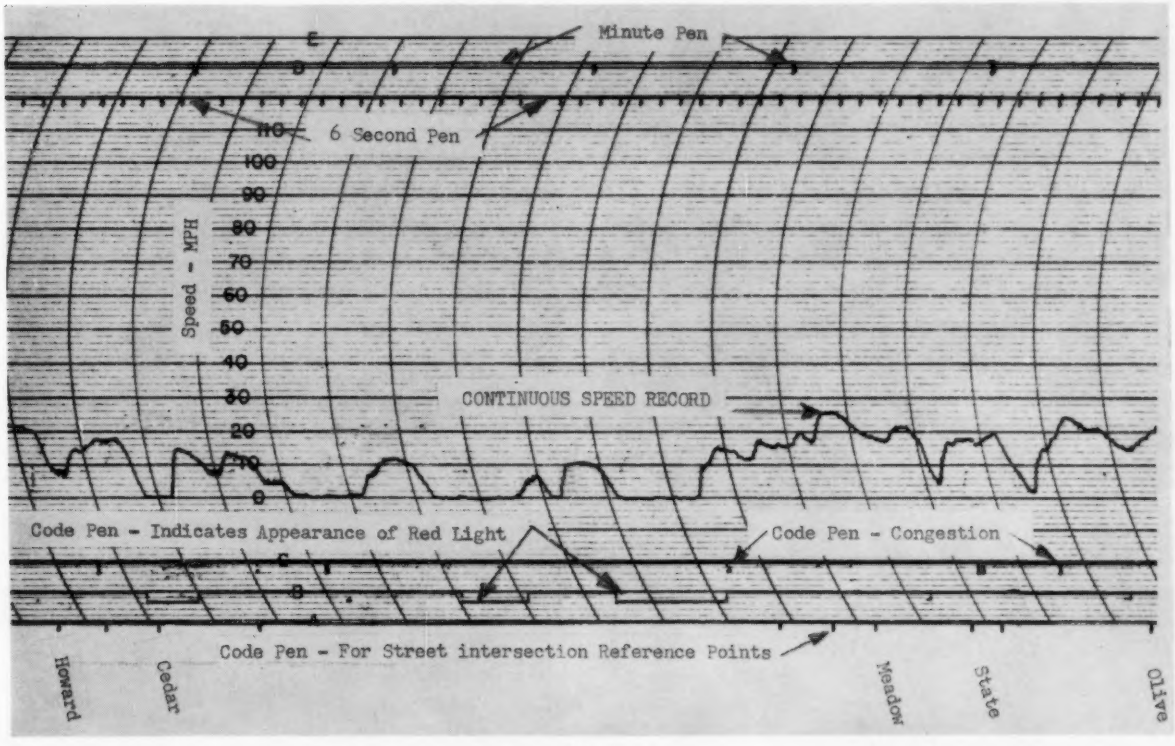


Fig. 4
Recording Speedometer chart showing portion of speed and delay run on U. S. Route No. 1, New Haven, Conn. Time and coding pens permit reference and selection of delay and congestion codes. Speed record is read as follows: (left to right) A stop at Cedar — code pen indicates red signal, acceleration to 15 m.p.h., slowing to 8 m.p.h., increasing to 13 m.p.h., slowing to stop, code pen indicates congestion, slight move up in traffic, acceleration to 12 m.p.h., stop again — code pen indicates red signal — slight accelerations to 6 and 10 m.p.h. — stop again — red signal — start again — acceleration and speeds to 26 m.p.h. at Meadow Street, etc.

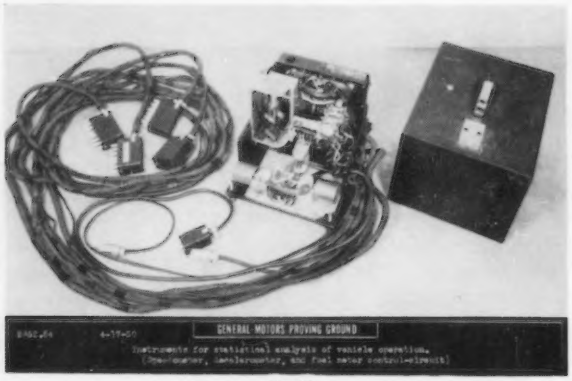


Fig. 5
Carmichael's instruments for statistical analysis of vehicle operation. Mechanical and electric appurtenances shown measure velocity, deceleration, fuel economy and acceleration.

nection to the cigarette lighter socket supplies power for the device.

The chart paper may be either driven by the spring-wound drive supplied with operation recorders or by connection with the speedometer cable, depending whether time or distance is used as a base. When time is used as a reference chart speeds of ¾, 1½, 3, 6, — 9, and 12 inches per minute are available through the standard gears ordinarily supplied. An almost infinite number of scales could be used when distance is used as a reference due to the many gear ratios available.

In operation, the Recording Speedometer is placed on the front floor of a car on the right side. Adjusting screws at leg ends enable the instrument to be leveled when in use to prevent ink spillage. Figure 3 shows the device placed in a car and ready for operation.

The advantages of graphic recording are indicated by the speed fluctuation charts produced. Figure 4 shows a chart record of a typical speed and delay run. (Time used as a reference.) The coding represents various delays encountered, as well as locations on the route.

The device is rugged, highly dependable, accurate and

Fig. 7
ITTE Travel Time Recorder which prints time to nearest hundredth of a minute. It also prints one of 12 code symbols at each printing.

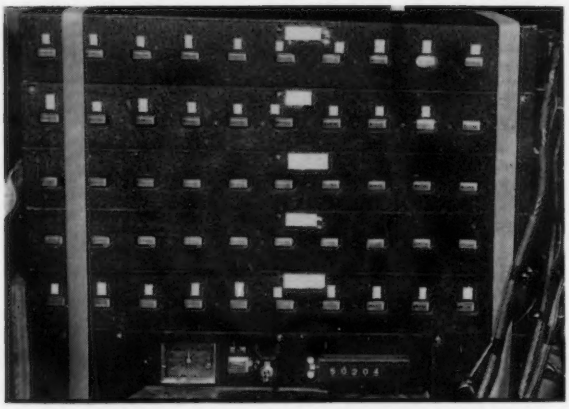


Fig. 6
Electric counter boxes which record qualities of velocity, deceleration, fuel economy, and acceleration (measured as engine torque and throttle opening).

thus far, free from maintenance difficulties. It will operate smoothly on rough city streets. It may be operated by the driver only, although more complete records are obtainable with an independent operator other than the driver. All component parts of the device are readily procurable, being standard parts used in taxi-meters, speedometers, etc.

The original (and so far, only) recording speedometer was built for the Bureau of Highway Traffic at Yale University, New Haven, Connecticut, by the Automatic Signal Company of Norwalk, Connecticut. Dr. Bruce D. Greenshield is using the device in research on the development of a "quality of transmission" index for urban traffic ways for the Yale Bureau. The results of this study will be presented at the Highway Research Board meeting next month.

Other Devices

Several other devices and techniques have been developed recently which merit a brief review at this time. These include the Vehicle Performance Instruments devised by Carmichael and Haley, the ITTE Speed and Delay Meter, the Traffic Chronograph and the Markel Camera method.

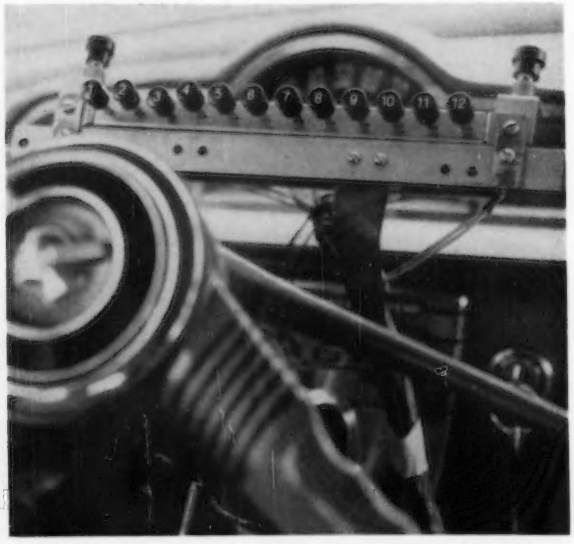


Fig. 8
Code Button assembly for ITTE Travel Time Recorder. 12 Symbol keys and printing button permit recording of delays, control points, intersections, etc., on speed and delay runs.

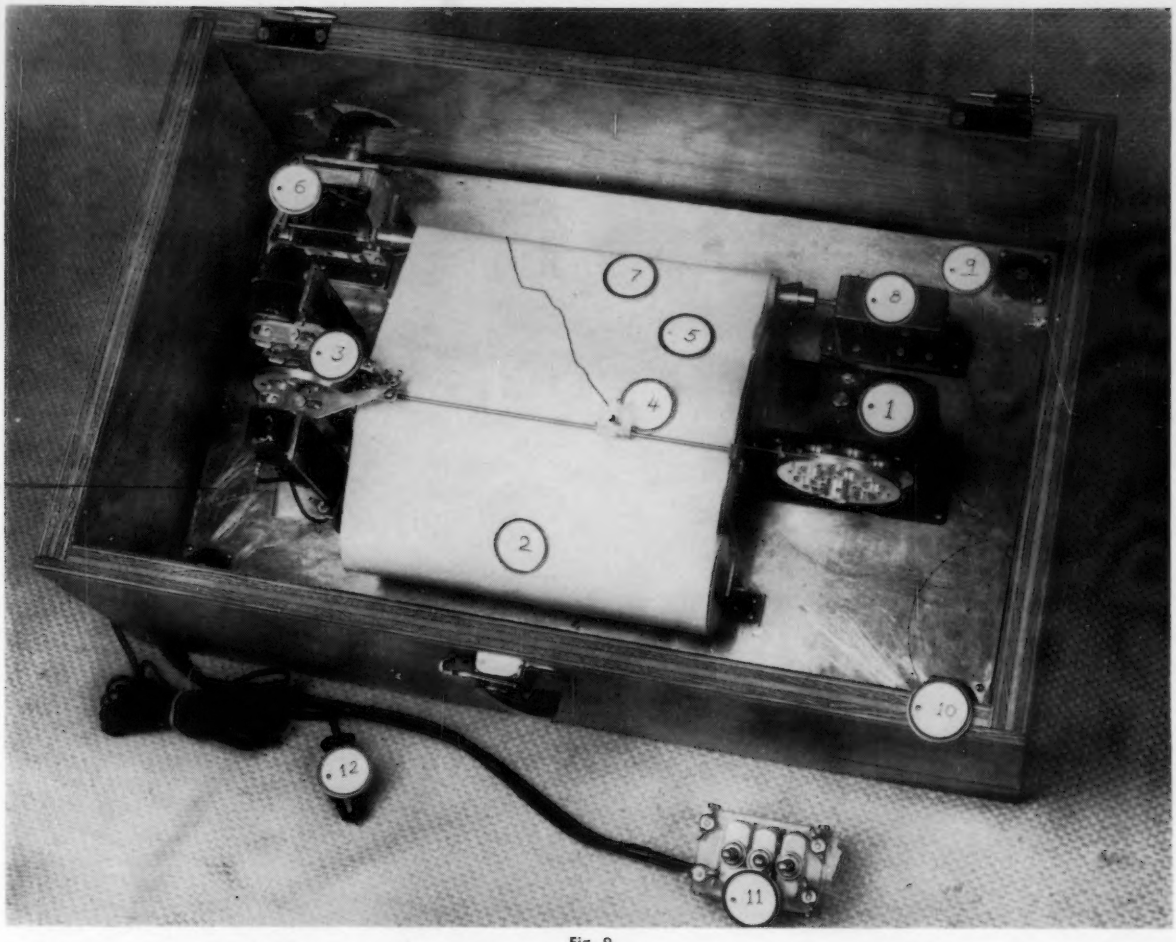


Fig. 9
The Traffic Chronograph. Numbered parts are identified as (1) Clock Drive, (2) Paper Supply Roller, (3) Dot-Coding Magnets, (4) Time Pen, (5) Tension Roller (underneath), (6) Drive Gear, (7) Drive Roller, (8) Releasing Cone, (9) Mounting Arrangement, (10) Manual Reset Wire, (11) Coding Switches, and (15) Power connection.

Vehicle Performance Instruments[2]

These instruments, developed by T. J. Carmichael, and C. E. Haley, record vehicle data such as velocity, deceleration and acceleration, as well as fuel economy. The instruments in general consist of five boxes containing ten electric counters each. These counter boxes are linked with various electrical and mechanical appurtenances in the car which will give the characteristics desired.

The instruments show significant relationships regarding fuel economy, braking speed, force and throttle opening. They also reflect differences in street performance due to functional changes in street operations such as installation of one-way streets, modified signal timing and the like. This instrument is not manufactured commercially but blueprints have been available for some time. A modification is now being developed which should improve the devices, namely the adoption of graphical recording attachments. Figures 5 and 6 depict these instruments.

ITTE Speed and Delay Meter[3]

This instrumentation, developed by the Institute of Transportation and Traffic Engineering, University of California at Berkeley, consists of a recording device designed to enable a driver to keep a running record of travel time and delays encountered. It uses a printing and timing assembly to record events presented by means of push buttons located near the driver. Figures 7 and 8 show these two assemblies. It is being manufactured commercially by the Streeter-Amet Company, Chicago, Illinois.

The Traffic Chronograph[4]

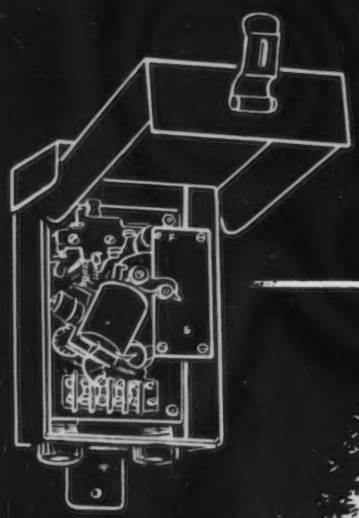
The Traffic Chronograph plots a chart which shows the relationship between distance traveled and the time needed to cover that distance.

The chart paper of the device is driven by a "T" connection from the car speedometer cable or extension of the speedometer cable and a pen is pulled across the paper by a clock timing mechanism. The sloped curve resulting is characteristic of this device. Figure 9 pictures this device. Indicators are provided for the marking of specific locations on the route or traffic situations. The resultant graph or chart gives a graphic picture of the speeds and delays along a route. This instrument was described in detail in the May, 1953 issue of TRAFFIC ENGINEERING.

[2] Carmichael, T. J. and Haley, C. E., "A Study of Vehicle, Roadway and Traffic Relationships by Means of Statistical Instruments," Proc. Highway Research Board, 1950: pp. 282-296.

[3] Details are presented in the ITTE Quarterly Bulletin, Vol. 5 — No. 3, June 30, 1954.

[4] Youngs, Robert, Jr. — "The Traffic Chronograph" — Traffic Engineering, May, 1953.



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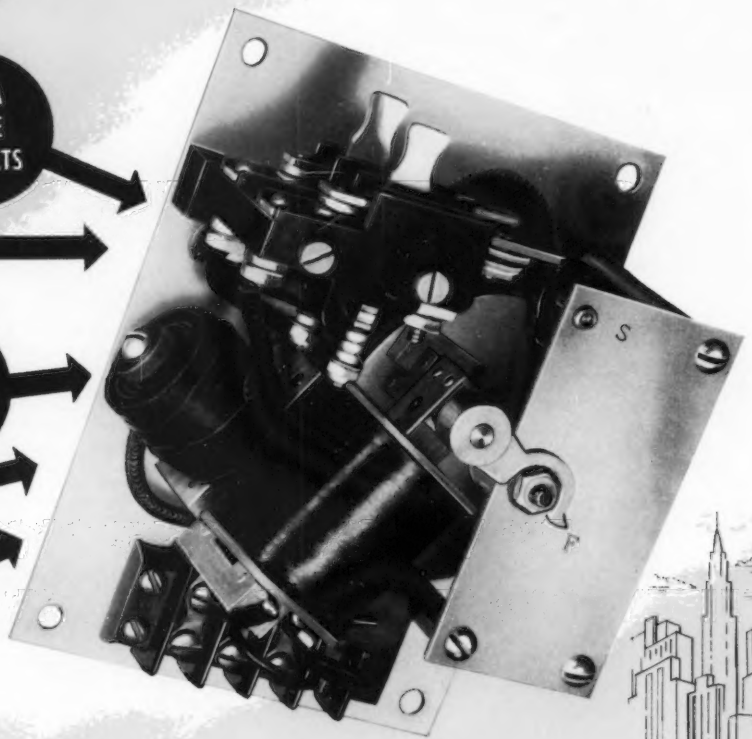

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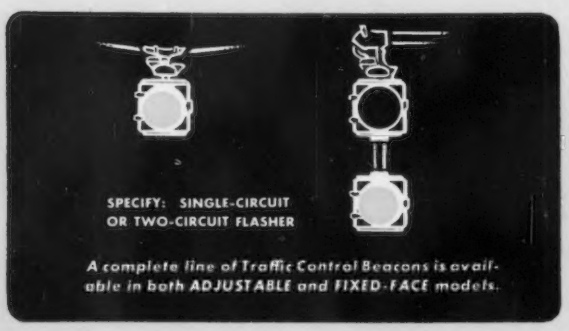

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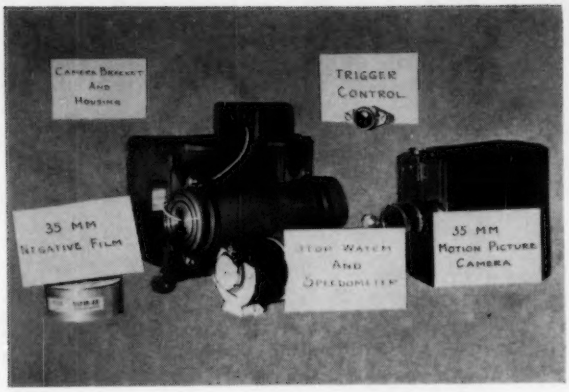

Fig. 10
Component parts of Markel Camera equipment. Camera bracket is bolted to the car top interior and pictures are taken through the window. Frequent pictures up to 16/second may be taken at operator's will.

An interesting urban street rating study was conducted by Robert Conradt[5] using the chronograph. This study concerned itself with evaluation of time savings, vehicle operation economy, comfort of the driver and passengers, and safety.

Markel Camera Method[6]

This method consists of gathering photographic data by means of the Markel camera. The 35 mm. motion picture type camera fits inside a housing which is bolted to the car top (pictures being taken through the windshield). A data chamber attached to the housing and bracket contains a stop watch and speedometer dial. (An extension speedometer cable connects this dial to the speedometer cable via a "T" connection.) Figure 10 presents the component parts.

Speedometer readings and times are photographed onto a corner of the film by means of a right angle prism between the data chamber and the film chamber of the camera. Single frame pictures are taken as desired by the operator by means of the push button trigger control. The developed film may be projected and speed and time information taken off as desired. Traffic conditions at the time are shown, a feature highly desirable. Figure 11 is a photo of a typical frame. This device is used in checking driver road habits of truck and bus firms insured through Markel Service, Inc. although law enforcement agencies and others are using the device. About 40 of these cameras are in use through the country.

Fig. 11
Typical photo taken with 35 mm. Markel Camera. Note speed and time readings which are photographed on upper right corner of the film.

Conclusion

Traffic instruments have not been used very widely in the past but new developments now being made available as well as previous instruments give the traffic engineer at least a few factual tools. Utilization of instruments will transfer the traffic engineer's reliance on skilled opinion to recommendations based on factual data. Such usage must come from the practicing engineer.

[5] Conradt, Robert — "Traffic Service Ratings for Urban Routes" — Thesis, Yale Bureau of Highway Traffic — 1954.

[6] "Markel" refers to Markel Service, Inc., international highway safety engineers and truck and bus insurers, Richmond, Virginia, who control the use of the camera.

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Including All Patterns and Dies,

Very Latest Styling.

Killark Electric Mfg. Co.

3940 Easton Avenue

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The G. E. Volume-Density Controller

By W. H. Beaubien

Engineer, General Electric Co., Lighting and Rectifier Department
West Lynn 3, Massachusetts

ACCORDING TO THE MOST RECENT available information, there were 53 million vehicles traveling our streets and highways in 1953 compared to only 33 million in 1946. In just seven years the number of vehicles registered has increased by a staggering 60%.

This means intersections considered satisfactory just seven short years ago are now called upon to pass more than half again as much traffic with a reasonable amount of efficiency and safety.

Grade separations may be desirable, but obvious economic hurdles will dictate that the great bulk of intersections will continue to be on a common ground.

This clearly indicates a national summons for increased use of vehicle actuated control, incorporating the highest possible traffic handling abilities. The new Type V "Volume-Density" traffic signal controller has recently been introduced to meet this requirement.

Although some of the traffic handling features of this machine are radically different from other presently available equipment, this paper will only serve as a generalized introduction to the device.

Figure 1 shows a picture of the controller and its front knob adjustments.

GENERAL

No distinction is made so as to favor either phase A (normally street A) or phase B (normally street B).

Unless the dials are set so as to favor one street or the other, then the prevailing volumes of traffic from one instant to the next will actually determine which street is the "major" street and which is the "minor" street.

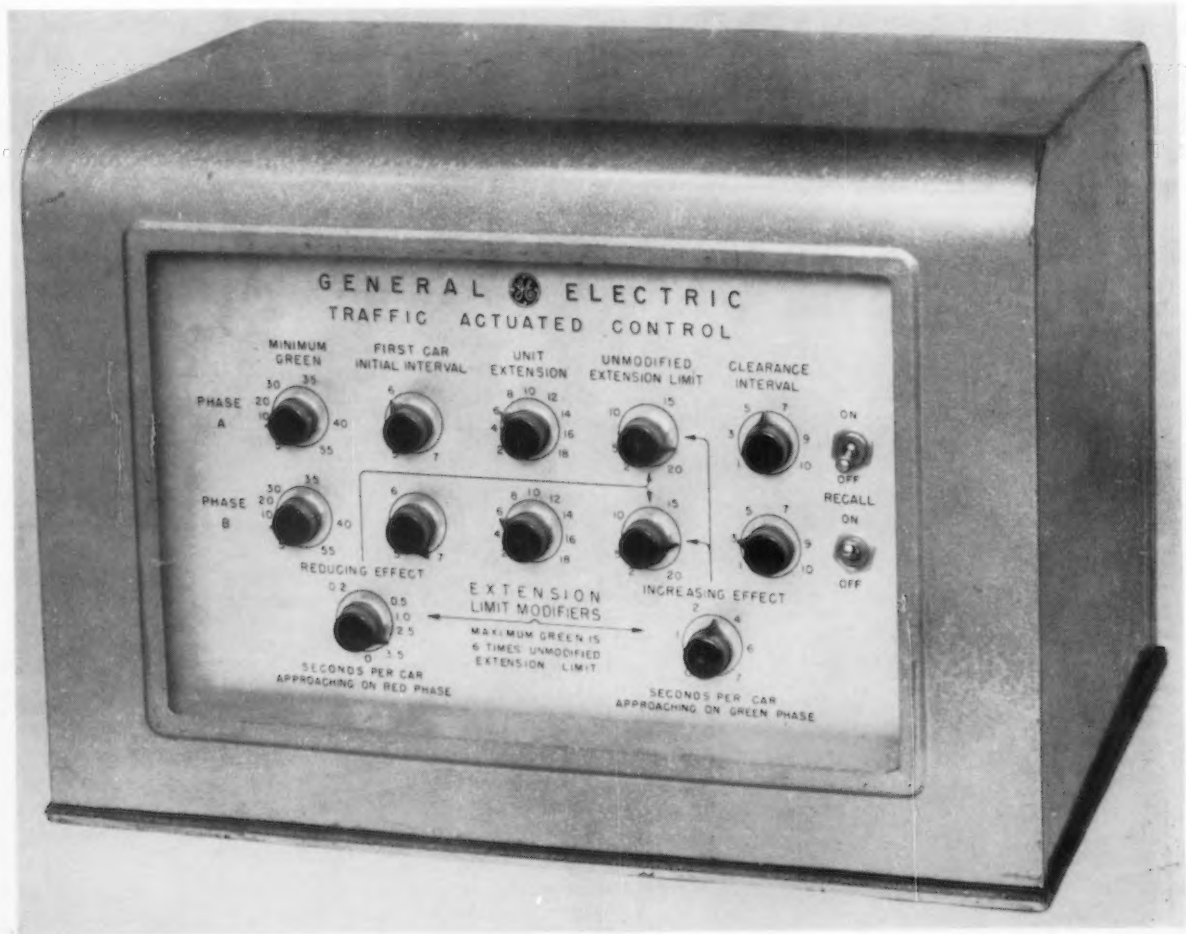


Fig. 1
Front of G. E. Type V full actuated controller.

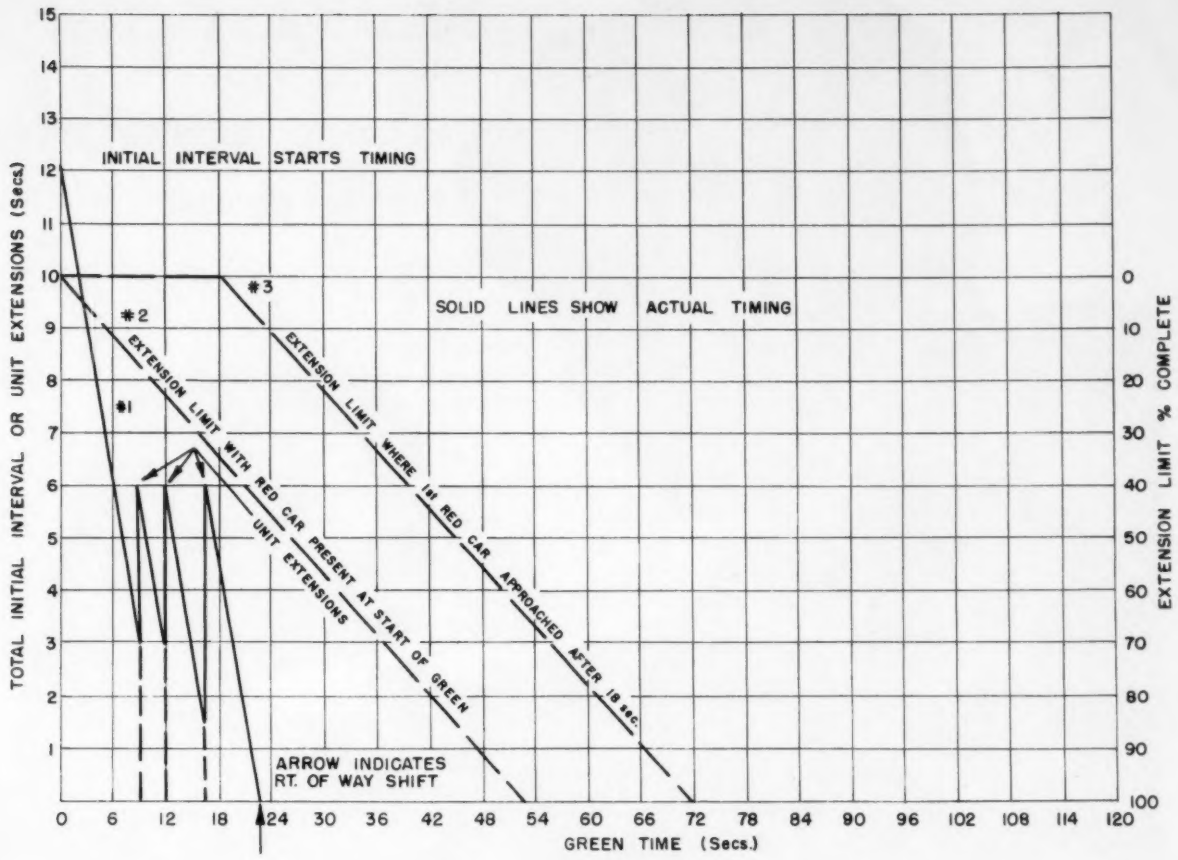

INITIAL INTERVAL STARTS TIMING
SOLID LINES SHOW ACTUAL TIMING
#1
#2
#3
EXTENSION LIMIT WITH RED CAR PRESENT AT START OF GREEN
UNIT EXTENSIONS
EXTENSION LIMIT WHERE 1st RED CAR APPROACHED AFTER 18 sec.
ARROW INDICATES RT. OF WAY SHIFT
TOTAL INITIAL INTERVAL OR UNIT EXTENSIONS (Secs.)
EXTENSION LIMIT % COMPLETE
GREEN TIME (Secs.)
0 6 12 18 24 30 36 42 48 54 60 66 72 78 84 90 96 102 108 114 120
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0 10 20 30 40 50 60 70 80 90 100

Fig. 2
Timing in full actuated traffic controller.

Standby Conditions

In the absence of traffic, the right-of-way stays on the street that last experienced an actuation.

Simultaneous A and B Detector Operation

When two vehicles actuate the detectors on two opposite streets at the same time (after a long absence of traffic), the green street vehicle is permitted to enter the intersection before the right-of-way is transferred to the initially red street. Even when the green street vehicle actuates its detector one-half of one second after the red street vehicle, the green street vehicle will still be favored. This is a safety feature, permitting the green street vehicle which is probably traveling at a high rate to continue, while stopping the red street vehicle, which is probably approaching the red light at a relatively slow speed.

Recall Switches

Recall switches are provided which automatically actuate the detector circuits once, each time the right-of-way leaves the street for which the Recall switch is thrown to the "on" position. If one Recall switch is thrown, the right-of-way will always return to that street even though there is no traffic on it. If both streets' recall switches are closed, then the controller will cycle with the minimum green given to each street—subject to modification by detector actuations. With the exception of the cycling operation, the controller will function exactly the same in all other respects as with the recall switches in the "off" position.

As an aid in clarifying the description, the timing functions will be divided into two main sections. These are, "Timing for Vehicles to Enter the Intersection," and "Timing for Limiting Total Green Time."

TIMING FOR VEHICLES TO ENTER THE INTERSECTION

Two Fundamental Timing Requirements

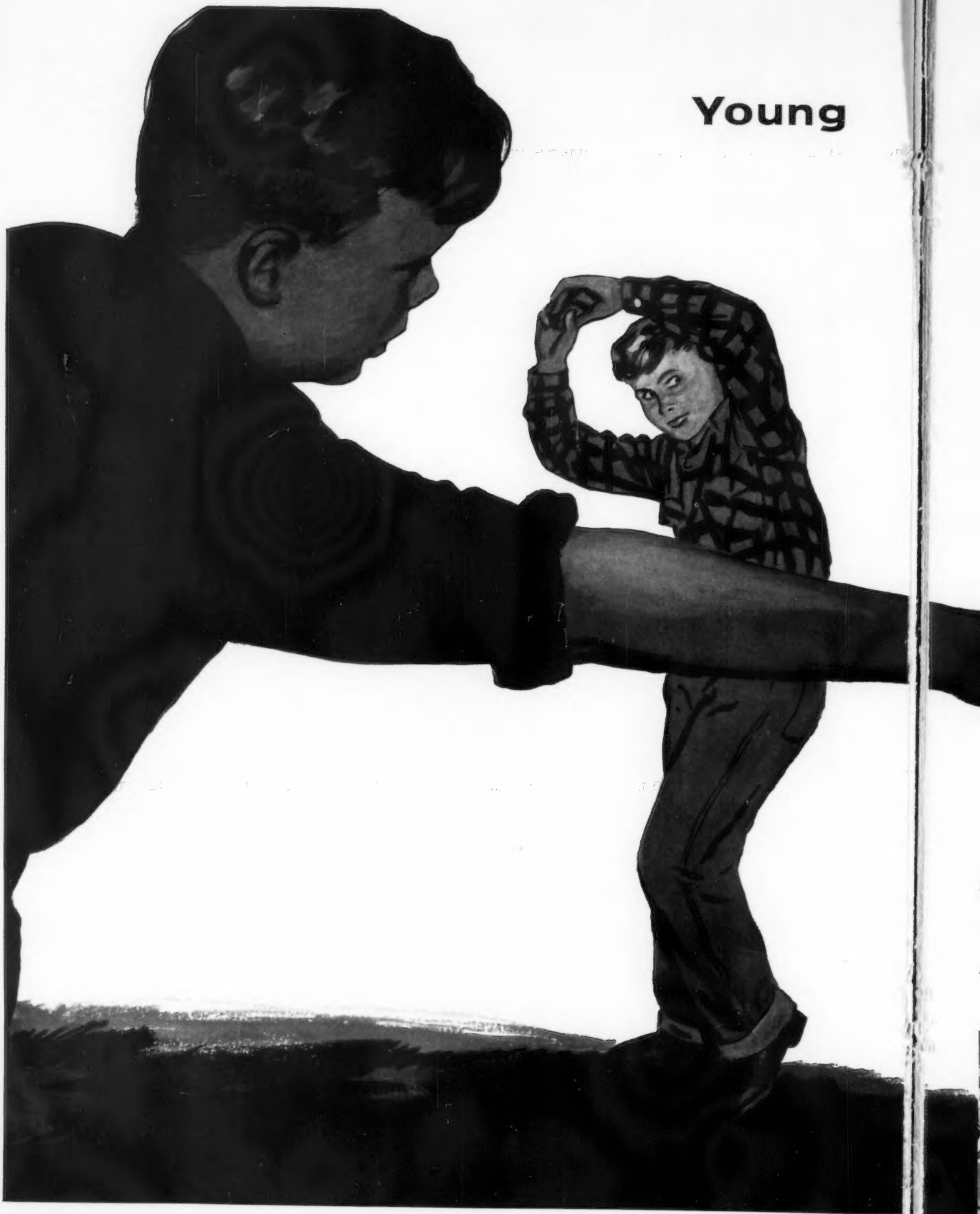
With an actuated control there are two fundamental timing requirements that must be met with regard to green time for vehicles to enter the intersection after they have been registered by the detector. These are: (1) where the detector is actuated during either street's yellow or its own red light, the vehicle comes to a stop, and will remain at rest until the green light is displayed and, (2) where the detector is actuated during a green light, and the vehicle is in motion.

In Fig. 2 an attempt is made to illustrate these timing functions graphically. Actual green time for the street in question is indicated wherever a solid line, having started on the extreme left edge of the graph, finally reaches the bottom line.

Traffic Variable Initial Interval

Cars that actuate the detector, as in requirement #1 above, build up a stored time known as the initial interval. This stored time does not start to expire until the green signal is displayed.

Curves No. 1 and 3 on Fig. 3 illustrate the build-up of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ALCOA ALUMINUM

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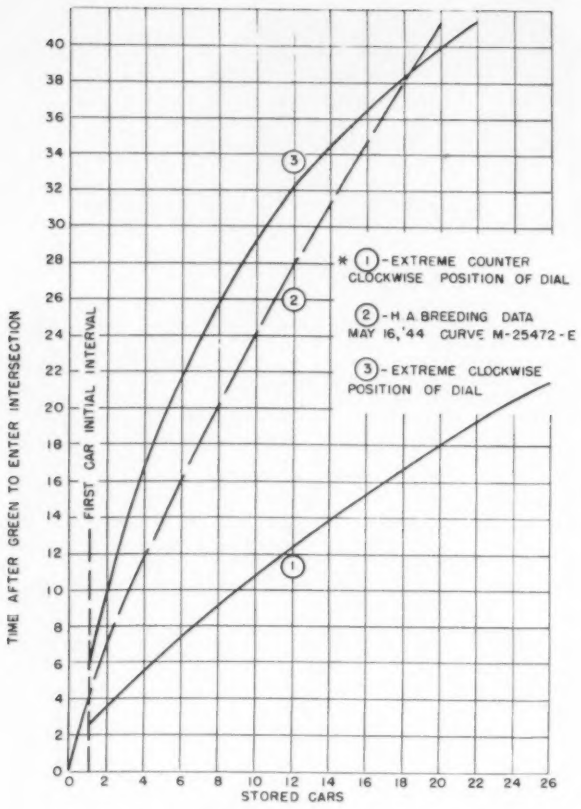
TIME AFTER GREEN TO ENTER INTERSECTION
FIRST CAR INITIAL INTERVAL
STORED CARS
* (1)-EXTREME COUNTER CLOCKWISE POSITION OF DIAL
(2)-H.A.BREEDING DATA MAY 16,'44 CURVE M-25472-E
(3)-EXTREME CLOCKWISE POSITION OF DIAL

Fig. 3
Traffic Variable Initial Interval Timing.
***With earlier type V Controllers this limit can only be realized by turning P-14 and/or P-16 fully counter clockwise.**

initial interval as stored traffic increases, with the former resulting from having the "First Car Initial Interval" adjustment in its extreme counter-clockwise position; and the latter, from having the same adjustment in its extreme clockwise position.

For streets with single lane approaches this adjustment should be set at 5 seconds. The resulting curve with normal detector spacings will approximate the actual curve demanded by traffic storing in a single lane, as is illustrated by Curve #2 in Fig. 3.

The initial interval accumulated in this manner determines the point on Fig. 2 where the timing curve intersects the zero vertical axis. If we assume four stored cars and a 5-second "First Car Initial Interval" setting, this would be 12 seconds, as determined from Fig. 3 and shown in Fig. 2. If no additional cars appear on this street, the green signal will ultimately be shown for 12 seconds and then the right-of-way will shift back to the other street (if one or more cars are waiting there).

Unit Extensions

Additional cars passing over the detector while the signal is green, however, would be examples of requirement #2. They produce unit extensions. These are illustrated in Fig. 2 along the same line as the initial interval. (Several of these appear like saw teeth). Each car returns the unexpired time up to a knob-adjusted level (6 seconds in Fig. 2); thus it could be stated that each car cancels the unexpired unit extension of the previous car and starts a new one. If there are no additional cars, then the right-of-way will shift when six seconds have elapsed since the last actuation (if there are one or more calls on the opposite street).

Need for Extension Limit

If these were the only features of the controller, cars spaced 6 seconds or less apart on the street with the right-of-way would retain that right-of-way indefinitely. However, their ability to extend the right-of-way should be limited. This introduces the Extension Limit, a timing function which is carried on *entirely independently of the traffic-variable initial interval and the unit extension as herein described.* (The extension limit is, however, influenced by the initial interval as will be shown in a succeeding section).

TIMING FOR LIMITING GREEN TIME

First Red Vehicle Starts Extension Limit

The Extension Limit on a Full-Actuated Controller begins timing out with an actuation on the red street. Starting the extension limit with an actuation by the first car on the red street, in effect, gives the controller the opportunity to analyze the instantaneous traffic conditions and transfer the right-of-way to the cross street at the most opportune time. It may be immediately with a break in green street traffic, or after a line of cars, then in, or approaching the intersection, has passed.

In Fig. 2, two different extension limits are shown: one which starts timing immediately as soon as the green light is shown; and the other which starts after 18 seconds. In the first case it is assumed that a vehicle was already waiting on the opposite street. In the second case no traffic appeared on the red street until after 18 seconds of green time had elapsed.

Note that as illustrated in Fig. 2 the extension limit would not have expired because the right-of-way shifted by reason of an expired unit extension.

Memory Feature

If there is an unexpired unit extension when the extension limit expires, then the memory feature goes into effect because a vehicle is between the detector and the stop line. Not having been given a full unit extension, the vehicle would not have had time to traverse the detector-to-stop-line distance. The memory feature, by taking effect, calls the right-of-way back again automatically.

Need for Traffic Variable Extension Limit

From what has been said so far, if traffic were time spaced less than a unit extension apart, the controller would operate as a pre-timed controller with a fixed amount of green time on each street equal to the setting on the extension limit dials.

The Type V, Full-Actuated controller has additional features which cause the controller to operate on Extension Limits that fluctuate with the relative densities of the traffic on *both* streets.

Extension Limit Increasing Effect

Cars passing over the detector during a green light increase the extension limit from the dial setting as a function of their density (time spacing between actuations). Fig. 4 shows the manner in which the extension limit is increased as the density of the traffic increases. Notice the very sharp rise in the characteristic as a density factor of ONE is approached. The density factor, ONE, is reached when the actual traffic density is equal to a figure predetermined by a dial setting. (This is shown by the definition of Df on the graph.)

Need for Difference Interval

Another requirement, not yet described, must be met if the extension limit increasing effect is to be successful. This requirement arises from the condition where vehicles occupy the entire distance from the detector to the stop line at the beginning of a green light for that street. All of these cars must get into motion before any cars in back of the detector can pass over the detector. During this "getting-into-motion" time, the extension limit is not being increased (i.e. there are no detector actuations) as it should be with bumper-to-bumper traffic.

Difference Interval

An interval known as the "difference interval" (because it is approximately equal to the total initial interval in effect minus one unit extension) is incorporated in the timer to permit a lower rate of detector actuation at the beginning of the green signal. This particular length of time is chosen because motion of the vehicles should be back to the detector at the end of the difference interval, as described. During the difference interval the extension limit is automatically increased just as if bumper-to-bumper traffic were passing over the detector, or, more specifically, as if the density factor were equal to ONE. (The density factor is defined in Fig. 4.)

Increasing Effect with Constant Densities

Fig. 5 shows various extension limits resulting from various continuous density factors. Note how rapidly the extension limit expires as the density factor is decreased (i.e. traffic thins out). The degree below the horizontal on the graph with each density factor is indicated so that a traffic engineer can use a graph of this type to predict the actual green signal that will result under any conceivable traffic condition. Notice that initial intervals and unit extensions are not shown on the graph. These timing functions are, of course, going on simultaneously with the extension limit but are left off of Fig. 5 to prevent confusing the intended illustrations.

Fig. 5 shows two different unmodified extension limit settings, 9 and 12 seconds. The term "unmodified" is used because it is the time that would result if no increasing or reducing effects (Extension Limit Modifiers) were employed.

Extension Limit Reducing Effect

The controller also experiences a reduction of its extension limit for *each vehicle* approaching the intersection on the red street. This is shown in Fig. 6. Curve "a" on Fig. 6 shows the extension limit in effect with a density factor of ONE on the green street and only one waiting car on the red street. Curve "b" shows the same condition except with two cars waiting on the red street and an assumed setting of 0.5 on the "Extension Limit Reducing Effect" knob. Notice that the second car made an incremental reduction of 5 seconds in the extension limit time from 120 seconds down to 115 seconds. Curve "c" shows four cars on the red street, where the timing is then reduced to 105 seconds.

Gap Recognition on Green Street

Examples which illustrate the manner in which gaps smaller than a unit extension are recognized by the controller are also shown in Fig. 6. During a gap in traffic the Extension Limit expires at two different rates. For the first part of the gap, that part equal to the setting on the Extension Limit increase dial, the Extension Limit expires as if the density factor were ONE. For the remainder of the gap, the Extension Limit expires as if the density factor were ZERO.

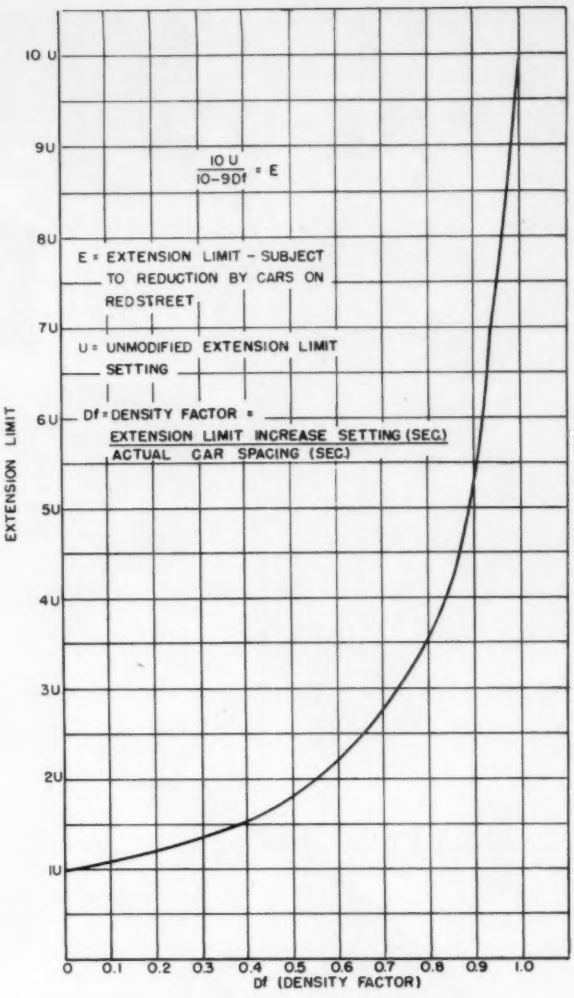

Fig. 4
Extension Limit L. C. Variation with density of traffic on green street.

In Fig. 6 Curve "d" shows a continuous density factor of ONE on the green street with eleven cars approaching on the red street; "d'" shows the effect of a gap slightly smaller than 6 seconds. (Recall that a gap has to be greater than 6 seconds to change the right-of-way by virtue of the expiration of the unit extension which is not shown in Fig. 6.) The resulting timing is shown as a very heavy extension of Curve "d," designated "d'." The gap is tolerated but the extension limit expires fifteen seconds earlier than it did without any gaps on the green street, as in Curve d. The total number of eleven-car reductions did not occur on "d'" for the simple reason that the extension limit expired and transferred the right-of-way before the ninth car approached.

Curve "e" shows the case where the eleven red-street cars approached at a faster rate. If no gaps occur on the green street, the timing is the same as it was in Curve "d" and as illustrated by Curve "e." However, if a gap occurs at precisely the same time as it did with Curve "d," then the right-of-way would shift on the gap, showing that the rate of traffic filling the detector-to-stop-line distance has a definite and positive effect on the gap tolerated on the green street, as it should.

The whole function of the extension limit can be thought of in the terms of gap recognition (on Figures 5 and 6 the

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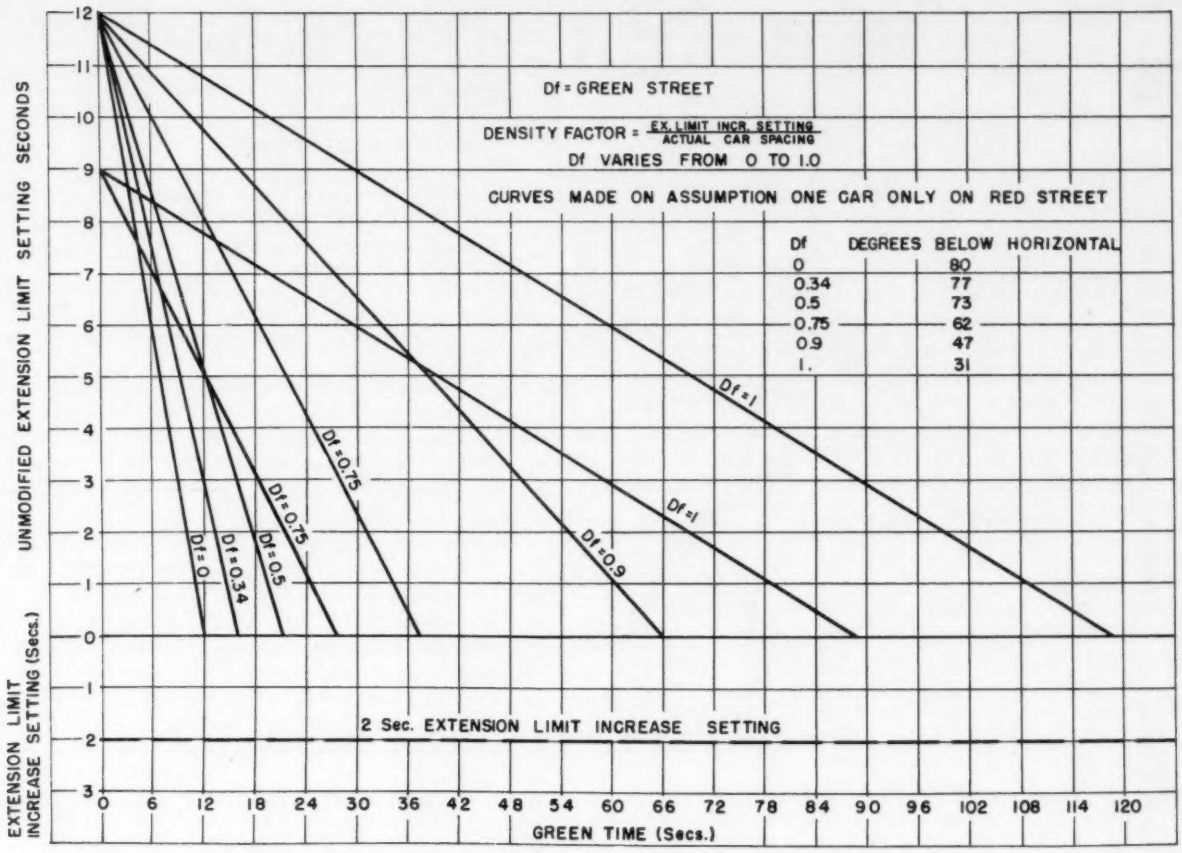
Df = GREEN STREET
DENSITY FACTOR = EX. LIMIT INCR. SETTING / ACTUAL CAR SPACING
Df VARIES FROM 0 TO 1.0
CURVES MADE ON ASSUMPTION ONE CAR ONLY ON RED STREET
Df DEGREES BELOW HORIZONTAL
0 80
0.34 77
0.5 73
0.75 62
0.9 47
1. 31
Df=1
Df=1
Df=0.9
Df=0.75
Df=0.75
Df=0.5
Df=0.34
Df=0
2 Sec. EXTENSION LIMIT INCREASE SETTING
UNMODIFIED EXTENSION LIMIT SETTING SECONDS
EXTENSION LIMIT INCREASE SETTING (Secs.)
GREEN TIME (Secs.)
0 6 12 18 24 30 36 42 48 54 60 66 72 78 84 90 96 102 108 114 120

Fig. 5
Extension Limit timing with constant density factors.

gap that will shift the right-of-way is determined by adding the unexpired "unmodified extension limit" to the "extension limit increase" setting), wherein the gap recognized at the start of the green is equal to the unmodified extension-limit setting plus the extension-limit-increase setting. As the extension limit is reduced by reason of sparsely-spaced vehicles, waiting time on the cross street, or by cars approaching on the red street, the gap which will be tolerated is shorter. Thus, gap toleration depends upon: (1) previous spacing of vehicles on the green street; (2) waiting time of cars on the cross street; (3) number of cars on the cross street; (4) rate at which the cars on the cross street have crossed the detector.

Even though a gap is tolerated by the Type V controller, its effect is permanent with reference to the extension-limit green time. The extension limit is reduced every time a gap occurs, so if one or more vehicles wait on the red street through a gap on the green street, no matter how short, this is taken into consideration by the controller, and the green street is penalized by a reduction of its extension limit.

Only a very few of the seemingly infinite possibilities of traffic conditions have been illustrated. Different adjustments of the dials will result in different effects.

Platoon Movements

Platoons are recognized, formed, and expedited by the Type V. The longer the line of closely spaced vehicles, the greater the possibility that the extension limit will expire with the gap at the end of the platoon and the right-of-way will return in anticipation of the next platoon. By setting the extension limit for the cross street at a relatively low value, closely spaced vehicles on the main street can be made to take the right-of-way away from the cross street by sheer weight of numbers. Thus a platoon, once it is formed, will take the right-of-way from the side street as it proceeds down the main street and retain that right of way until a gap in the platoon occurs.

SUMMARY

The new Type V "Volume-Density" controller has all of the features of a standard full-actuated traffic signal controller plus traffic variable initial intervals, traffic variable extension limits and a special interval known as the difference interval. As a result, the device when employed at an intersection will:

1. Produce snappier right-of-way switching under light traffic conditions (traffic variable initial interval).

2. Penalize the green street for any and all empty intersection time (rapid decrease of extension limit as traffic on green street thins out.)

3. Reduce allowable green-street empty intersection time with increased density of traffic on red street (extension limit reducing effect).

4. Recognize and *remember* all gaps in traffic (10 times faster expiration of extension limit during *all* gaps).

5. Consider waiting time and number of red street vehicles, and also immediate previous history of green-street

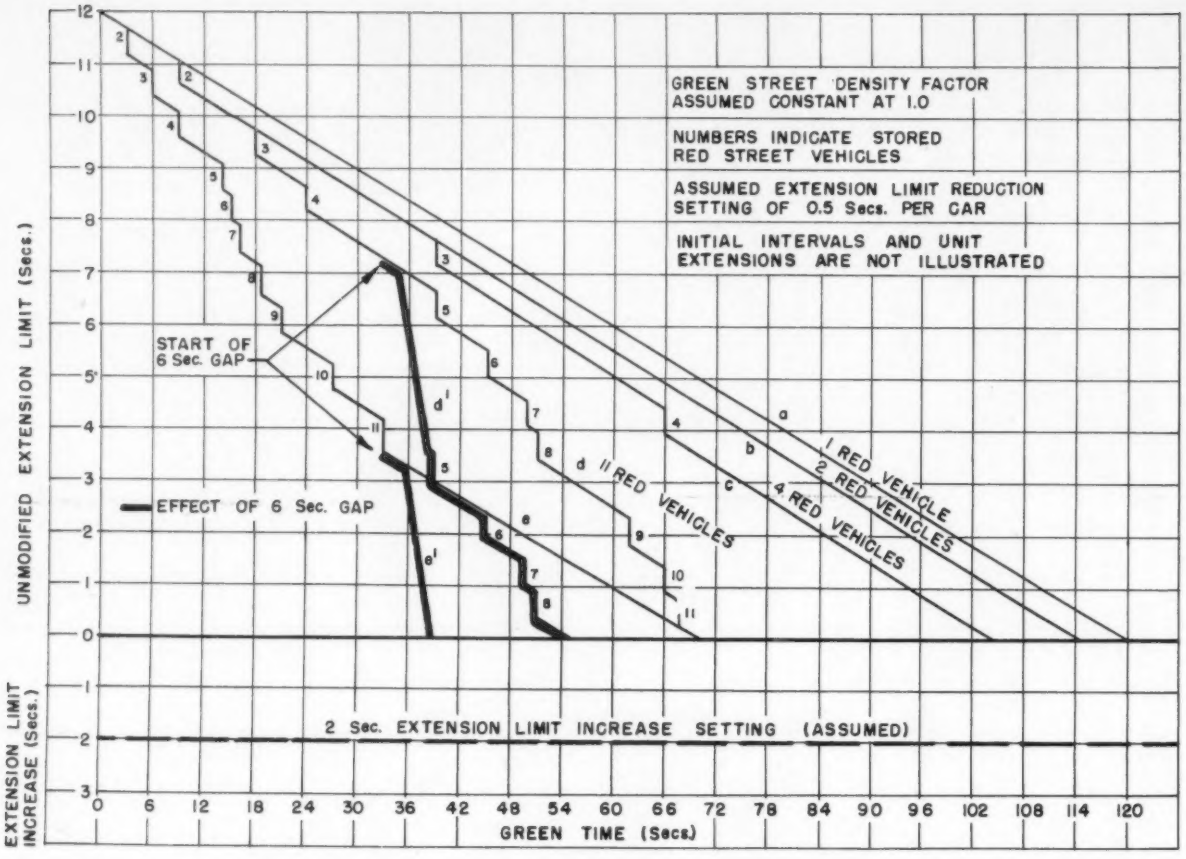
GREEN STREET DENSITY FACTOR
ASSUMED CONSTANT AT 1.0
NUMBERS INDICATE STORED
RED STREET VEHICLES
ASSUMED EXTENSION LIMIT REDUCTION
SETTING OF 0.5 Secs. PER CAR
INITIAL INTERVALS AND UNIT
EXTENSIONS ARE NOT ILLUSTRATED
START OF
6 Sec. GAP
EFFECT OF 6 Sec. GAP
1 RED VEHICLE
2 RED VEHICLES
4 RED VEHICLES
d II RED VEHICLES
2 Sec. EXTENSION LIMIT INCREASE SETTING (ASSUMED)
UNMODIFIED EXTENSION LIMIT (Secs.)
EXTENSION LIMIT INCREASE (Secs.)
GREEN TIME (Secs)
0 6 12 18 24 30 36 42 48 54 60 66 72 78 84 90 96 102 108 114 120

Fig. 6
Extension Limit timing — Reducing effect plus gap recognition.

density in determining gap to transfer the right-of-way (variable gap response results from traffic variable extension limit).

6. Consider stored traffic at the beginning of the green signal on the green street in density calculations for that street (difference interval).

7. Permit lower rate of detector actuation at beginning of green signal (difference interval).

8. Consider the rate of storage of red-street traffic when determining length of gap to transfer the right-of-way (Figure 6.)

9. Extend green-signal timing sharply as one street's capacity is approached (Figure 4.)

10. Minimize back-up under all conditions (each and *every* vehicle that actuates the detector and may be kept waiting reduces the waiting time for the red street).

11. Form and expedite platoons (results from all its inherent characteristics).

New Subway Has Slowed Flight to Suburbs

The new Toronto subway "has provided a positive rebuttal to those who urge that the provision of more facilities for the motor car is the only answer to traffic ills," the Fall General Meeting of the American Institute of Electrical Engineers was told in October, at Chicago.

The system, which was put into operation on March 30 of this year after an expenditure of nearly $58,000,000, "has demonstrated its ability to restore the downtown area to its rightful position as the heart of the city," J. G. Inglis, operations manager of the Toronto Transit Commission, observed in a paper describing the subway operation. "It has slowed down the flight to the suburbs. . . . It has proved that a vigorous transportation agency, alert to the varying needs of the area it serves, can face the future with confidence. And it provides a challenge to myself and my fellow Institute members to gather and provide the facts and information to our Managements so that each transportation system can be a leader, and not a follower, in its Community."

The four and a half mile subway, the first in Canada, and the fifth in North America, has many novel features, Mr. Inglis said, including sound insulated cars, subway platforms and tunnels, which provide an exceptionally quiet ride; four experimental aluminum cars, in addition to 100 cars of steel; novel temperature controls; doors that run on rollers; a lighting system that is adequate for reading, and electrical features providing the latest in controls and safety.

"Operation of the first few months," said Mr. Inglis, "has already justified the wisdom and courage of those who conceived, planned and built the system."

Value of The Traffic Engineer

By Saville Dorfman (Mem., ITE)

Assistant Traffic Officer & Traffic Engineer, Traffic Department
Bree and Harrison Streets, Johannesburg, South Africa

This Article which first appeared in THE OPEN ROAD, official bulletin of the South African Road Federation, is condensed from a paper read before the Federation.—EDITOR.

THE INTRODUCTION OF MODERN transport during the past half century has resulted in problems along the roads which the former designers and engineers did not foresee. Traffic congestion and accidents are playing a vital part in our lives and the costs to the community are enormous. The engineer, who normally plays a great part in the planning of our modern towns and roads, has thus had a new responsibility thrust on his shoulders.

South Africa has advanced in many ways, and the introduction of Traffic Departments, whose functions are solely devoted to the control of traffic and are completely divorced from the control of criminal activities, is, in my opinion, a step in the right direction.

However, it has only recently been acknowledged that traffic is a science and that a scientific approach must be made to the subject.

In the United States of America Traffic Engineering Schools to train Traffic Engineers have been operating for a number of years. The Department of Transport, together with the University Authorities, is now investigating the possibility of the establishment of a training course in traffic engineering.

It is my opinion that every city and local authority should employ a traffic engineer who has been fully trained. When this is not possible, I feel that the civil engineer should devote himself to the study of traffic engineering in order to apply at least its major principles to any design which he may have to carry out.

I would suggest that either of the following two methods could be adopted in the case of the smaller towns: (1) Traffic consultants could set up offices in South Africa and be called in to advise smaller municipalities, and (2) Traffic engineers, employed by the Department of Transport, could advise these smaller towns.

The traffic engineer is an essential to every traffic department and he should have a proper technical staff.

It is necessary to set up an Accident Bureau so that accidents may be fully investigated. The Hollerith system of tabulating causes, types, etc., of accidents should be instituted. From these tabulations it is possible to effect the improvements necessary and also to obtain data for the enforcement of traffic policies. In so far as the engineer is concerned, it is necessary for him to have spot maps prepared. These spot maps show, by means of pins, where the accidents occur and their classification according to severity and type. It is possible to include much more data on the spot map, but care should be taken not to overload the types of pins as the map will not then be a great aid to the engineer. The map should present a visual picture which immediately shows up bad accident spots. Any other information that is required may always be obtained from the classifications that have been made from the Hollerith system.

Any filing system used should be generally of the card system, and, by means of attaching tabs, it should be possible to evolve a high accident list. After the engineer is presented with (1) Spot Maps, (2) High Accident Lists, (3) Location Files, a programme should be drawn up to treat a certain number of high accident intersections or streets per year. When putting this programme into operation the first and obvious duty is to prepare condition diagrams. This is prepared in order that the engineer has a survey of the location with all details of trees, poles, kerbs, road widths, grades, etc. The traffic engineer thereafter prepares a collision diagram on which is shown by means of arrows the types and location of accidents which have occurred at that point. The traffic engineer also makes parking studies, speed studies, destination studies and any other special observation studies that may be necessary to enable him to obtain the full information required.

With all this data available, he is then able to prepare a traffic scheme for the re-design of the particular intersection or street. The engineer's duty after plans have been prepared and a new design constructed does not end. He is required to give publicity to the new design and also carry out a re-check after the changes have been made in order to see whether the accident rate has been reduced. If the re-design fails to reduce the accident rate it is obvious that additional engineering or control is required, otherwise he has made some fundamental mistake.

It must, however, not be thought that the engineer's duties are only to reduce accidents along the road, but traffic planning must also be carried out. Present day traffic has increased to such an extent that major alterations to towns are necessary and a major traffic plan should be prepared for every city. This can only be carried out by an extensive study of the traffic problems of each city. Town plans which are prepared purely upon the opinion of the town planner or engineer and which have not had the necessary studies carried out generally fail to improve conditions. Widening of a particular street because congestion happens to be present therein is not necessarily a proper remedy. It is necessary to carry out a large number of surveys and studies, such as volume counts, origin and destination studies, cordon counts, transportation carrier studies, parking studies, speed and delay studies, pedestrian volume studies, commercial vehicle studies, etc.

In Johannesburg we have recently prepared a major traffic plan. The origin and destination studies and the volume count enabled us to determine where the necessary arterial roads, bus routes and termini should be placed. A cordon count, together with other studies, enabled us to determine the off-street parking requirements that were necessary and also the most suitable point where these should be located.

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It was found that during the peak period it was necessary to park 8,500 vehicles. Allowing for an increase in population and registration of cars it was determined that parking facilities were required for 12,500 vehicles. The plan, therefore, has made provision for the off-street parking and parking at the kerb for this number of vehicles.

The engineer is called upon to make a scientific approach to the solution of traffic problems. He must supply streets safeguarded with signs, signals and regulations that will carry the vehicular and pedestrian traffic. It is not only engineering and the provision of signs that is necessary, but also efficient traffic aids. The engineer should face the problem of the various types of traffic, curves, high hill crests at which sight distance is limited, intersections, parking and other obstructions.

The traffic planner should regulate traffic to help drivers and pedestrians, but should not over-regulate, planning should be of a continuous nature.

In treating high accident locations, it is essential that the correct methods of design be used after all the traffic information has been obtained. Too often expensive re-designs of intersections are carried out which are totally unnecessary.

The funds available are often the determining factor in any plan presented. However, it is essential that the people of South Africa should realise that the problem of traffic cannot be solved without the expenditure of large sums of money. Expressways, overhead passes and clover leaf designs will have to be used to solve the traffic problems of the larger cities. The burden of finance must be borne not only by the local authority, but also by the national and provincial authorities.

Yearbook Changes

ADAMS, George S. (Junior)
Assistant Traffic Engineer, State Road Department of Florida, Traffic and Planning Division. SEND MAIL: 310 North Gadsden Street, Tallahassee, Florida.

BARKLEY, Robert E. (Associate)
Assistant Planning Engineer, City-County Planning Board, City Hall, Winston-Salem, North Carolina.

BATTS, Herman M., Jr. (Junior)
Traffic Engineer, Municipal Parking Authority, 1214 Griswold, Detroit 26, Michigan.

BECKENBACH, Lt. Col. Charles G. (Member)
Company A — APO 757, 8th Transportation Traffic Regulation Gp., New York, New York.

BRITTON, George R. (Associate)
Chief Traffic Analyst, Highway Planning Division, Pennsylvania Department of Highways. SEND MAIL: 4001 Ash Street, Harrisburg, Pennsylvania.

CROSBY, John R. (Junior)
Assistant Traffic Engineer, New Jersey Turnpike Authority. SEND MAIL: 118 Willow Avenue, Route No. 24, New Brunswick, New Jersey.

EXNICIOS, John F. (Associate)
Assistant Traffic Engineer, Division of Traffic Engineering, 306 City Hall, New Orleans 12, Louisiana.

GALLAGHER, John L. (Junior)
Assistant Traffic Engineer, Division of Traffic Regulation & Engineering, Room 112, Safety Building, Columbus 15, Ohio.

MATYAS, Lt. Curt A. (Junior)
United States Marine Corps. SEND MAIL: 320 Tassagra, San Luis Obispo, California.

POWILLS, Michael A., Jr. (Junior)
Associated Consultants — Traffic Engineer, 415 Church Street, Evanston, Illinois.

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TRAFFIC NEWS

Traffic Volume Hits The Ceiling

Tokyo Metropolitan Police Department carried out a survey on the traffic volume of motorcars, bicycles, slow carts, and pedestrians at 92 main intersections in the city limits for three days beginning from March 24.

According to its result recently publicized, average figures in 12 hours from 7 A.M. to 7 P.M. are: motorcars, 2,006,497; bicycles, 957,506; slow carts, 33,134; pedestrians, 2,405,286. As compared with the results of the last year's similar survey, it is noteworthy that every figure of surveyed items grew bigger, but the percentages of increase proved to be rather smaller than those in the previous year as seen in the following table. Thus, the tendency of increase seems to have hit the ceiling.

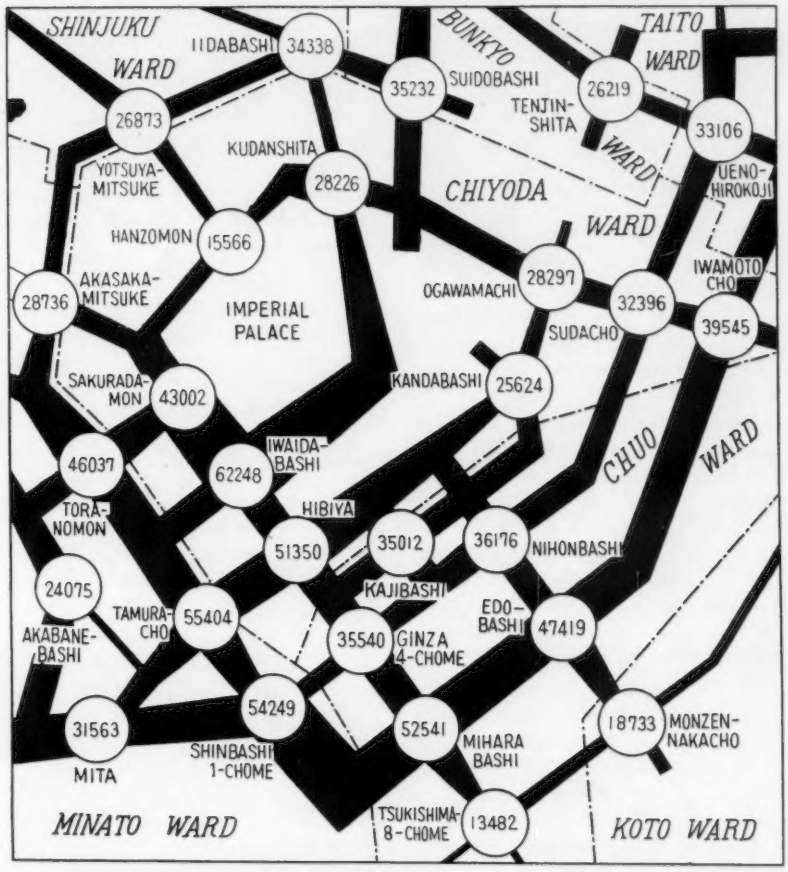
Items	Time		Traffic Volume	Percentages of Increase
Motorcars	Sept.,	1953	1,845,202	32.0
	March,	1954	2,006,497	8.7
Bicycles	Sept.,	1953	904,674	21.5
	March,	1954	957,506	5.8
Slow carts	Sept.,	1953	32,417	8.1
	March,	1954	33,134	2.2
Pedestrians	Sept.,	1953	2,120,892	23.6
	March,	1954	2,405,286	13.4

Motorcars: The heaviest congestion of motorcars is found in the city center to the southeast of the Imperial Palace and in this area the Iwaida Bridge intersection is pinpointed as the most congested point in the city limits, the traffic volume there being 62,248 cars.

The number of the crossings where 30,000-odd cars passed was 23, compared with 19 witnessed in the last year's survey. The ratio between the numbers of cars and trucks is 1.8 against 1, showing little difference from the figure reported in the previous year.

Bicycles: The most congested points are found chiefly in the downtown, the highest figure shown in a certain crossing being over 33,360.

Slow Carts: Slow carts, such as handcarts and oxcarts may be out of question as today's conveyance. The figure of 33,134 reported in this year's survey occupies only about one-half of the owners' total which has been dwindling yearly, showing the range of availability.



The figures show the numbers of automobiles passed through the main intersections in the central part of the city during 12 hours from 7 A.M. to 7 P.M. on the day the survey was made by the Metropolitan Police Department.

Pedestrians: Motorcars crowd into the city center, bicycles concentrate in outskirts, but pedestrians naturally cluster around business quarters and school areas.

The central intersection of Ginza ranks at the top of the grades of pedestrians traffic volume, recording 187,999 in twelve hours, the maximum per hour reaching 23,261.

Traffic volume and traffic accidents: Traffic volume of motorcars rises in the morning as follows: 9-10 A.M., a sharp upward curve; 10-11 A.M., peak of the curve; 12 A.M.-1 P.M., downward curve. In the afternoon the curve again draws a slow upward line until it reaches the peak between 4 and 5 o'clock and turns downwards sharply from 6 to 7. Motorcar accidents proved to have generally occurred during one hour with the peak as its middle point.

The curve denoting pedestrians traffic volume abruptly rises from 8 to 9 A.M., turns downwards from 9 to 10 A.M., and rises again from 12 A.M. to 1 P.M. The lowered curve makes the third rise from 3 P.M. to the peak seen in between 5 and 6 o'clock and after that it falls sharply. Regardless of this waved line, the curve of pedestrians' accidents shows steadfast upward trends throughout one day, forming the peak within one hour from 5 to 6 o'clock in the evening, that is, the frequency of pedestrians' acci-

dents does not depend upon the traffic congestion of pedestrians.

In other terms, the accident tolls are not commensurate with the traffic volume. It may be the reason why the tolls do not necessarily rise in the rush hours of morning, noon and evening, that the passers-by in these critical hours are for the most part commuters and students who have been well trained in the practice of safe traffic.

—Tokyo Municipal News

Buffalo Pigeon Hole Parking Successful

A year's operation of the six-level Pigeon Hole parking structure in downtown Buffalo, New York, has provided some relief for the existing acute parking shortage. Business has increased steadily and the garage is nearly filled daily, meeting approval from its operators, motorists and city officials.

The steel skeletal structure is 65x165′ and furnishes space for 250 cars where 100 were parked before in a lot. It is made up of six-story steel framing in two parts with three elevators in a corridor between. The front of the structure is enclosed and floors are covered and waterproofed to prevent dripping.

Operating expenses are very considerably under those of ramp garages according to the garage manager. Seven men staff the $250,000 structure. It is located within easy walking distance of Buffalo's City Hall, the State Building, the Federal Building, and other major office buildings.

In operation, the hydraulic powered elevators travel the length of the building along rails between the "shelves." Resembling trolleys, the elevators hoist an automobile aboard and travel until a vacant bay is found. The floor of the elevator then moves upward to the designated level and deposits the car in an empty bay.

Day parking rates at Pigeon Hole Court are 35 cents for the first hour and 15 cents for each additional hour. The maximum day rate is $1. Night rates are 50 cents for two hours or less and 15 cents for each additional hour.

The building is operated by the Hanna Garage Company of New York, Ltd., on a ten-year lease. Because of the city's desire to encourage construction of off-street parking facilities, the garage is exempt from real estate taxes for fifteen years.

Pigeon hole garages have also been built in Tacoma and Spokane, Washington; Portland, Oregon; Boise, Idaho; Los Angeles, California; Phoenix, Arizona; Madison, Wisconsin, and Youngstown, Ohio.

Hal H. Hale Resigns AASHO Secretary Post

Hal H. Hale, executive secretary for the American Association State Highway Officials, announced his resignation from that post during the Association's recent annual meeting in Seattle, Washington. Mr. Hale is to become the new executive secretary for the Association of American Railroads.

Alfred E. Johnson, Chief Engineer of the Arkansas State Highway Department, will succeed him as AASHO Executive Secretary, effective January 1, 1955, it has been announced.

Mr. Johnson, who, during 1954 has served as President of AASHO, is a native of Harrison, Arkansas. He studied engineering at the University of Arkansas and has been a member of the Arkansas State Highway Department since 1927.

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Special Governor's Committee Urges Federal Responsibility For Interstate System

The special Governors' Conference Committee on Highways has proposed that the Federal Government assume primary financial responsibility for construction of a 40,000-mile interstate road network and has prepared a six-point program for improving the nation's highways.

This was reported by NHUC in an Information Service bulletin November 12. Since that date, additional information has been received.

At its recent meeting in Chicago, the committee also recommended that the Federal Government contribute $25 billion over the next ten years as its part of the more than $100 billion estimated cost of correcting the nation's highway inadequacies.

Copies of the six-point program of recommendations have been sent to all state governors. A meeting of the Conference's Executive Committee in Chicago is scheduled for November 30.

The recommendations are reported to contain the following points:

1. An adequate highway construction program for the next twenty years should require the expenditure of twice as much money as is presently anticipated.
2. For financing purposes, the various highway systems should be divided into three categories—the interstate system, including essential urban access roads, other Federal-aid systems, and the state and local systems.
3. Since the government has a major interest in the interstate system because of national defense and commerce needs, it should assume the primary financial responsibility.
4. The government's $25 billion portion of the cost for the next ten years should be secured from general revenue, the issuance of bonds, or by the establishment of a national road financing authority. During fiscal 1953, the government received $979 million from its motor fuels and lubricant taxes and $1.4 billion from motor vehicle excise taxes.
5. States or their political subdivisions should be responsible for the actual construction, maintenance, administration and policing of their portions of the system.
6. States and localities will continue to have responsibility for construction of all other systems with the provision that as long as the government levies taxes on fuels and motor vehicles, it will continue to make allocations to the states for highway construction.

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Present at the meeting of the special committee were Governors Paul L. Patterson, Oregon; Allan Shivers, Texas; Walter J. Kohler, Wisconsin; Robert Kennon, Louisiana; Frank Lausche, Ohio, and Howard Pyle, Arizona. Two other members of the committee, Governors Lawrence Weatherby, Kentucky, and John Lodge, Connecticut, were unable to attend.

AASHO Supports President's Road Proposal

The American Association of State Highway Officials, at its annual meeting in Seattle, in November, gave enthusiastic support to President Eisenhower's proposal for a greatly expanded highway construction program and recommended "a new program with the necessary capital expenditures substantially financed by the Federal Government."

The states should be responsible for the design and construction, AASHO added, and the states should "assume cost of maintenance, operation and policing of the system, which is to be constructed to adequate standards, as promulgated by AASHO."

The group said a program should be adopted so that the interstate system and its urban extensions would be completed within ten years "to further the national defense and the peacetime economy."

AASHO also went on record as favoring continuance of Federal funds for the Federal-aid secondary, urban and primary highway systems, less the interstate portion, "in at least the same amount as at present."

Special Governors' Committee Makes Recommendations

In a collateral development, the special Governors' Conference committee studying President Eisenhower's highway proposal recommended that the Federal Government spend $25 billion in the next ten years for interstate highways, as well as continue to aid with primary and secondary roads.

Meeting in Chicago, the committee declared that the Federal Government should assume primary responsibility

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for the interstate system to guarantee uniformity, particularly as long as the Federal gas tax remains in effect.

The committee's recommendations will be given to the executive committee of the Governors' Conference November 30 in Chicago.

du Pont to Resign

In another action at the AASHO meeting, Francis C. du Pont, U. S. Commissioner of Public Roads, announced that he will resign from that post effective early in January to become a special assistant to Secretary of Commerce Weeks. He said Deputy Commissioner C. D. Curtiss, veteran Bureau employe, will succeed him.

Mr. du Pont said the change will enable him to devote full time to the President's highway proposal. He explained that this would be impossible in his position with the Bureau because of the heavy burden of administrative details.

New Policies on Annual Meetings Adopted

Last month this magazine reported that the ITE Board of Direction had adopted certain new policies relative to the conduct of Annual Meetings. At the last meeting, September 29th, the Board took the actions recommended by the report of the Special Committee of Directors which had been appointed to study the problem. At the same time, the Executive Secretary was directed to publish the report in an early issue of this magazine so that the ITE Membership at large will be fully aware of the overall policies governing the conduct of future Annual Meetings beginning with Pittsburgh in 1955.

The report in full follows:

To The Board of Direction,
Institute of Traffic Engineers

In response to request of President McNeil at the January 1954 Board Meeting, the undersigned Committee of Directors undertook a study of past annual meeting reports and recommendations with the view of submitting policy recommendations pertaining to annual meetings. These recommendations were to include site selection and method of selection, type and content of technical sessions program; typical expense budget and means and methods of securing necessary funds. A preliminary report of this study was submitted for consideration at the June 1954 Board Meeting. After some discussion and with certain changes and modifications the recommended policies were adopted in principal by the Board. This study, embodying the results of the action by the Board in June is to be submitted at the Annual Meeting this date for appropriate action by the Board.

Recommended Board Policies for Annual Meetings

As directed by President McNeil and in accordance with the earlier discussion and action by the Board, the undersigned Committee of Directors of ITE submits the following recommendations as Board Policies for Annual Meetings for consideration and appropriate action by the Board at its Annual Meeting in Kansas City, September 26-29, 1954.

Site Location

The Wehmeyer Report, dated August 12, 1952, and acted upon by the Board at its Annual Meeting the same year, recommended that the annual meeting sites be rotated on a geographical basis using either the six districts or no less than five other geographical areas for the basis of rotation.

Supplementing this general recommendation of the Wehmeyer Report, it is recommended that:

a. The annual meetings be rotated among the six Districts with no two meetings located in the same District within a six-year period, unless there be compelling reasons to depart therefrom.

b. Membership within the District to which the annual meeting is allocated shall recommend the specific city.

c. A District not in a position to put on an annual meeting allocated to it shall not be required to accept the assignment.

Technical Sessions

After carefully reviewing the problem of the technical sessions the Committee concludes that a major effort should be made to improve the quality of presentations and to create a degree of prestige which should accrue to those persons invited to present technical papers at the annual meetings. To this end the Committee offers the following recommendations:

a. That whenever possible a retiring Director be appointed Chairman of the Technical Sessions Committee for the following annual meeting.

b. That the Chairman of the Technical Sessions Committee solicit the assistance of each Local Section for suggestions of capable persons who could make noteworthy presentations.

c. That a draft of the Technical Program be presented to the Board for review at each January meeting preceding the annual meeting to which the program pertains.

d. That the format include four technical sessions and an optional field trip. For example, the format could be as follows:

First Session—Presentations on Education, Planning and Administration or on subjects closely allied to the Traffic Engineering field.

Second Session—Presentations on surveys and regulations, mass transportation and other subjects of direct concern to the Traffic Engineer.

Third Session—Composed of two concurrent sessions, one comprising of selected subjects of primary interest to the City Engineer such as one-way streets, parking devices and off-street parking facilities, and the other designed to interest State Traffic Engineers with such subjects as origin and destination, speed and delay and route surveys. Other subjects, such as signs, markings and other traffic control devices might be applicable to both groups of traffic engineers.

Fourth Session — Presentations devoted to geometric design, channelization and similar subjects of general interest. This session may also serve to permit description of projects to be noted on subsequent field trip.

Fifth Session—Technical field trip (optional).

Typical Expenses and Budget

The following may be considered as a guide for estimating a maximum budget for financing annual meetings:

(Based upon Chicago and Buffalo experience—registrations averaged 350, excluding ladies.)

Item	*Amount*	*Amt. Subsidized*
Ladies' Activities	$1,000	$1,000
Luncheons (2)	1,000	—
Banter Breakfast	500	—
Banquet Cocktail Party	500	500
Banquet	2,500	—
Programs & Misc.	500	500
Headquarters Room	1,500	500
Technical Sessions	200	200
Field Trip	500	—
Reservations Committee Printing	100	100
Publicity Committee Expenses such as letterheads, programs, tickets, postage	1,000	1,000
Miscellaneous	700	700
	$10,000	$4,500

Thus $4,500 is necessary to obtain for the operation of the annual meeting. It is suggested that the Board authorize ITE to furnish up to $3,500 as follows:

Registrations @ $3.00 Est.	$1,000
Annual Meeting Revolving Fund	2,500
Total	$3,500

This leaves only $1,000 necessary in cash or contributed service to be raised by local committee from local sources without solicitation of sustaining organizations.

It is believed, however, that with prudent budgeting and the elimination of extras and non-essentials, little if any difficulty would be experienced in accomplishing a budget of $8,500 or less. This would reduce amount to be furnished from ITE and obtained locally.

Means and Methods of Securing Necessary Funds

Fifty commercial organizations who manufacture and/or distribute materials, equipment or services used by the traffic engineer in his profession and who have made contributions in money or service to past annual meetings, were canvassed by means of a confidential questionnaire to ascertain the opinion

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of the majority of the organizations as to how they felt about aiding the Institute in financing the annual meetings. On the basis of the results of this canvass, the following recommendations are made:

a. Authorize the establishment of a special Annual Meeting Revolving Fund to begin with the fiscal year 1955 with an amount up to $2,500 from national headquarters funds to be set aside for assistance at future annual meetings. Any additional subsidy required for annual meeting to be obtained locally and without soliciting sustaining organizations.

b. In view of the predominant sentiment of commercial manufacturers opposing formal exhibits at ITE meetings, the Board of Direction considers this to be undesirable and unnecessary as a form of financing the annual meetings.

Respectfully submitted,
EDWARD G. WETZEL
Chairman
Director, District 1
JOSEPH E. HAVENNER
Director, District 6
ROBERT S. HOLMES
Director, District 2
MATTHEW C. SIELSKI
Director, District 4

EXTRACT FROM MINUTES OF SEPTEMBER 29th BOARD MEETING:

69. Report of Director's Committee on Conduct of Annual Meetings

By motion, duly seconded, the Board VOTED adoption of the entire Committee Report—as revised in its several parts by several previous Board approvals—as Board Policies to govern the conduct of future Annual Meetings.

Confusion and Clarification — What General Clay Actually Said

A great deal of confusion has resulted from November newspaper accounts of talks by General Lucius D. Clay, Chairman of the President's Advisory Committee on a National Highway Program.

The accounts have quoted General Clay as saying that the Federal program for expanded highway construction has been cut from a proposed $50 billion to $24 billion, which would be financed by revenue bonds over a thirty-year period.

Here is what it all actually means, according to a Clay Committee spokesman:

The total Bureau of Public Roads estimate of $101 billion needed for highway construction during the next ten years still stands.

During those ten years, however, it is estimated that approximately $47 billion will be spent by all levels of government through the normal course of events.

This leaves a balance of $54 billions from the BPR's $101 billion estimate.

Now, what General Clay actually has been saying, a committee spokesman explains, is that his committee has decided that of this $54 billion figure, the Federal Government should pick up the tab for $24 billion — with most of this amount designated for the Interstate System. And that is the figure the Clay Committee is trying to determine how best to finance.

Deducting the Federal Government's proposed share from the $54 billion leaves $30 billion worth of construction to be financed on the state, county, township and city levels.

The Clay Committee wants this additional $30 billion raised by these other governmental units so that the entire proposed $101 billion program can be accomplished. But it has decided, in effect, that it will concern itself only with plans for financing the Federal Government's share—$24 billion—of the

(Continued on page 130)

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1824 EAST SECOND WICHITA, KANSAS

Strictly Business

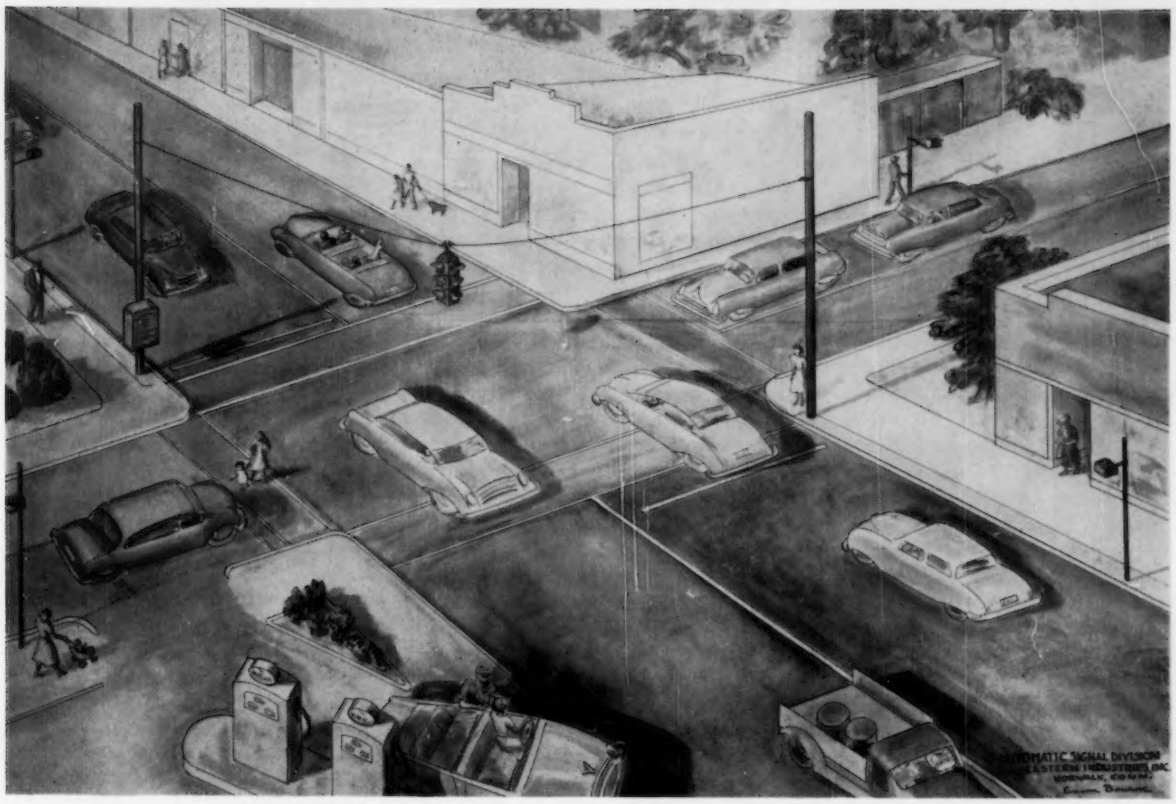


Fig. 1
This is an artist's drawing of a street intersection, where vehicular traffic is controlled by radar equipment manufactured by Automatic Signal Division, Eastern Industries, Inc., Norwalk, Conn. This radar equipment is located on four stanchions near the corner of each of the city streets.

Automatic Signal Division Develops Radar Detector

Radar, so successfully used in detecting shipping on the high seas and planes through the air is now being enlisted in the solution of another transportation problem, the guiding of 60,000,000 motor vehicles through miles of overworked street and highway intersections. This new radar equipment has been under development for a number of years and the first commercial installation was put into operation last spring at East Avenue and St. John's Place in Norwalk, Conn., a short distance from the business center of the city, where it has demonstrated its ability to handle traffic with superhuman efficiency. The equipment is now in commercial production and installations have been ordered for various streets and highways throughout the country.

Radio Detection and Ranging — in other words RADAR — in its newest role has been harnessed to work as a component in high-efficiency traffic signal control. This development is the accomplishment of Eastern Industries' Automatic Signal Division at Norwalk, Conn., the same organization that developed and introduced the Electro-Matic Radar Speed Meter a few years ago. In its new role radar is truly a detecting and a ranging device, for it is a beam of radar microwave energy that is directed toward the vehicles that approach the intersection under control.

With radar detection, a beam of microwaves from an overhead "eye" is directed down each of the intersecting streets. These "eyes," perhaps more properly termed antennae, are relatively small units adaptable to mounting on post or arm in such a position that their controlled beam of microwaves is focussed upon oncoming traffic lanes. Installation and adjustment are such that vehicles enter the zone of the beam at the proper distance from the intersection, which normally is from 100 to 400 feet depending upon traffic and geographical characteristics of the intersection.

As each moving vehicle comes to the detection area the microwaves impinge upon it, a portion of the energy being reflected back and picked up by the small overhead antennae. This system of radar detection is sensitive to vehicle motion at all speeds, so that there is supplied to the controller a record of the pattern of approaching traffic. Each vehicle registers its approach but once.

The power required by the radar component of a traffic actuated signal system is extremely small. Drivers and pedestrian traffic are completely unaware of its operation. The radar equipment is unaffected by weather or other normally attendant conditions. The units are designed for ease of mounting and installing and are ordinarily not noticed by passing traffic. One unit properly positioned and adjusted is sufficient to scan each entering street and will pick up and send to a highly efficient electronic brain the accurate and around-

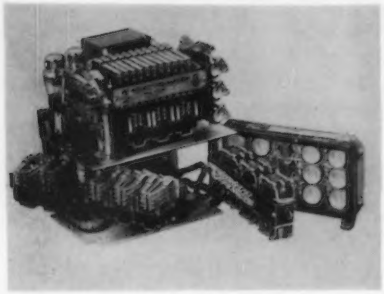


Fig. 2
This is a picture of the interior of the "MAGIC-BRAIN" Electro-Matic Control Equipment which transmits the radar signal and automatically directs traffic flow.

the-clock picture of the approach pattern of traffic which is necessary to insure that the intersection area be used to fullest advantage in passing through maximum volumes of traffic with minimum delay.

Radar is by no means a stranger to the traffic scene. The application of the radar principle to the control of street traffic has been the result of a research program extending over a number of years. One product of this research program is Automatic's well-known Electro-Matic Radar Speed Meter. Microwave energy is today being used in almost every state in the nation as a means of detecting accurately and instantaneously the speed of moving vehicles for enforcement and traffic engineering purposes. Many a speeding motorist has found himself confronted with the indisputable evidence of the radar speedmeter, scientific proof of his violation of rules of the road.

Just how does radar work in traffic signal control? First let's take a look at the signal control equipment with which it has been integrated. Again Eastern enters the picture, for it was the Automatic Signal Corporation (now Eastern's Automatic Signal Division) that twenty-five years ago introduced a new term to the vocabulary of traffic engineers—"traffic actuated control."

Prior to 1927 traffic signal controllers had been operated by a sort of electric clockwork mechanism that rotated the green light in a fixed time cycle between the two intersecting streets. Even at that early date the suspicion was growing that there was something wrong with this scheme of things. The signals were blind to actual traffic flow and could do no more than obey their clockwork setting, irrespective of what was happening to traffic.

This was "fixed time control" and if the setting was 30 seconds of green on Main Street and 20 seconds of green on State Street, this schedule was adhered to regardless of whether State Street happened to be the heavier of the two at the time. Not only this, but time and again the signal would hold up a string of moving cars on one street and shift to the other on which not a car was present. Small wonder that congestion and delay were fostered and motorists' tempers were not improved.

Traffic-actuated control changed all that. Eastern's Electro-Matic system added eyes and brains to traffic signals and operated them on the demand principle. Approaching vehicles signalled their approach, their number and spacing, so that the actuated controller could respond and apportion the green light in accordance with the ever-changing traffic pattern at the intersection. Thus the right-of-way was allocated on the basis of actual demand and the inefficiency and loss of time caused by the shifting of the green light to an empty street, while impatient motorists waited, were eliminated.

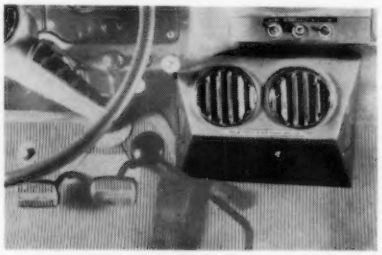
Traffic-actuation was first introduced in 1928 in New Haven, Conn. From this beginning Electro-Matic traffic-actuated methods have grown to be a standard means of handling difficult traffic control problems. Today, many thousands of intersections from coast to coast and in foreign countries are traffic actuated. Equipment has been developed for controlling all conceivable types of intersections on city streets and trunk highways, much of it highly specialized and all of it designed to move maximum traffic volumes with the least delay and highest possible safety.

Traffic actuated signal systems must "see" the actual traffic conditions at the intersection and therefore it is essential that they be provided with some means of receiving information about oncoming vehicles. This information can be obtained by several methods of detection. Commonly used are the Electro-Matic pressure-sensitive detectors and magnetic detectors. As implied by the name, the pressure detector is operated by the pressure of automobile wheels rolling over its surface. The magnetic detector depends for its operation upon the magnetic effect of a moving vehicle. Both of these types of detectors have proven thoroughly satisfactory. They are however surface and sub-surface structures which necessitate pavement excavations for their installation, and their effective range is limited to the immediate vicinity of the detectors.

By incorporating the magic eye of radar into the Electro-Matic traffic control system all components of the system have been brought above the ground, at a considerable saving in installation cost. At the same time the effective range of operations has been extended to cover an entire area of the street. The radar beam is flexible and can readily be adjusted to new requirements brought about by alterations to the intersection. If the street should be widened, or repaved or made one-way, or changed in any way, the radar detector can be easily adjusted to meet the new situation without any of the expenses normally involved in remodeling street and highway installations.

Air Conditioner for Autos Announced

The first *low-priced* refrigerated automotive air conditioner to be placed on the market, selling for around $300 plus installation, has just been announced by Frigikar Corporation, 1602 Cochran, Dallas, Texas, a pioneer in the industry, to bring summertime motoring comfort within reach of the masses. The passenger car unit bears the trade name Frigiking, while the adaptation for trucks and truck-tractors is labeled Frigikab, according to Bert J. Mitchell, Frigikar president. At the same time,



he announced model improvements in the forthcoming 1955 Frigikar luxury car air conditioner. Frigikar already is nationally distributed, having been in production since 1949.

Both Frigiking and Frigikab, with attractive under-dash housings that contain the evaporator, blower-fan, thermostat, and air-direction louvers, automatically hold in-car or in-cab temperatures in the 70-degree comfort zone. Up to 365 cubic feet of refrigerated air per minute are delivered for comfort at low or high speeds, in 100-degree-plus weather, without detracting from engine efficiency or increasing battery strain. Under the hood are the same heavy-duty compressor, condenser, receiver, drier, and solenoid valve components

(Continued on page 126)

How to make the change to RED

America's New Standard

Part 1, Section 29 of revisions to The Manual on Uniform Traffic Control Devices, dated September, 1954:

"Owing to the importance of Stop signs they are given a distinctive shape (octagon) and color (red). The red color is consistent with the accepted use of a red light as a Stop signal and of the color red as a special warning of danger."

Here are three ways you can make the change to red quickly . . . easily . . . inexpensively!

1. BUY THEM READY-MADE: The ALRED-101 is a complete sign of Wide Angle Flat-Top "Scotchlite" Reflective Sheeting mounted on sturdy 61-ST-6.081 Aluminum. This is a strong, flat, easy-to-maintain sign ideal for replacements of existing signs. The ALRED-101 is available in 24", 30", or 36" sizes.

2. BUY UNMOUNTED SIGN FACES: Screened red Stop faces of Wide Angle Flat-Top "Scotchlite" Sheeting ready for application to new or refurbished blanks. Easily applied with either a vacuum applicator or by hand. And see how inexpensive:

	QUANTITY		
Size	10-20	24-45	50 and more
24"	$3.80	$3.60	$3.40
30"	5.90	5.60	5.30
36"	8.50	8.05	7.60

(Minimum order, 10 faces.)

3. MAKE YOUR OWN using Wide Angle Flat-Top silver "Scotchlite" Reflective Sheeting. Silk screen with our No. 712 Stop Sign Transparent Red.

DETAILED SPECIFICATIONS ON REQUEST. Specifications including Reflective Characteristics, Layout, Screening Techniques, Metals and Metal Preparation will be sent on request. Write or use coupon below.

For true shape ... true color ... and true legend ... by night as well as by day

REG. U.S. PAT. OFF.

SCOTCHLITE BRAND **REFLECTIVE SHEETING**

CLIP and MAIL Minnesota Mining and Mfg. Co. St. Paul 6, Minn. TE-124

Please send me Red Stop Sign Specifications.

NAME.....

TITLE.....

ADDRESS.....

.....

The term "Scotchlite" is a registered trademark of Minnesota Mining and Manufacturing Co., St. Paul 6, Minn. General Export: 122 E. 42nd St., New York 17, N. Y. In Canada: London, Ontario, Canada.

New Audible Alarm System Polices Traffic Speed In Critical Areas

A new electronic device developed by Zonealarm Corporation, 712 East 163rd Street, Cleveland 10, Ohio, reduces speed of traffic in critical areas such as school zones, recreation areas, small communities and congested areas.

Zonealarm Audible Alarm Systems are installed at each entrance to speed

zones and vehicles entering zones in excess of pre-selected speeds set off a short siren warning. The audible warning alerts drivers that they are exceeding speed limits—warns pedestrians that vehicles are entering zone at excessive speeds and points an audible "accusing finger" at violators as an aid to law enforcement officials. According to the manufacturer, the Zonealarm System is accurate and reliable and simply installed and serviced.

A spokesman for the company stated that the new Audible Alarm System *was developed primarily to protect approaches to schools* but is equally effective for other critical area installations. A few of the advantages pointed out by the company are the automatic operation of the device during preselected times only; the elimination of manpower to operate the units as required by radar and electric timing devices; the audible warning that alerts drivers, pedestrians and law enforcefent officials and the low initial cost and maintenance of the unit.

According to the manufacturer, in test installations at schools where the Zonealarm System is pre-set to sound alarm between 8:00 A.M. and 9:00 A.M.; 12:00 P.M. and 1:00 P.M.; 3:00 P.M. and 4:15 P.M. the system is doing an excellent job of slowing traffic with the effects carried over throughout the day.

In a typical Zonealarm School Installation warning signs are set at each school entrance in the following manner: 750 ft. before the school zone sign reads, "Warning, Audible Alarm for Excessive Speed"; 500 ft. before school zone sign reads, "School Zone—20 M.P.H."; 250 ft. before school zone sign reads, "Slow, School Zone Ahead." Any motorist disregarding the warnings and exceeding the pre-selected speed sets off the device and reduces speed immediately at the siren sound.

Literature describing the Zonealarm System is available upon request from the manufacturer.

AIR CONDITIONER FOR AUTOS
(Continued from page 124)

found in the luxury-car air conditioners. Units are easily and economically installed and transferred from one car or truck to another, reports Mitchell, with upkeep practically nil. Frigiking is even practical for convertibles!

Fleet owners, after a preview showing, stated that they consider safety records will be improved through decreased driver fatigue. Frigikar announces the appointment of Hobbs Manufacturing Company as Southwestern Frigikab distributors for Texas, New Mexico, Oklahoma and Kansas.

IACP Yearbook Available

The International Association of Chiefs of Police recently announced that the new 1954 Police Yearbook is available at a price of $3.50 per copy.

This Yearbook covers the proceedings of the 60th Annual Conference of the IACP held in Detroit, Michigan, September 13-17, 1953, and is a valuable reference book for all phases of police work and interests, such as committee reports—civil defense, communications, cooperation, crime prevention and juvenile delinquency, education and training, police administration, public relations, traffic law enforcement and supervision; proceedings of the State and Provincial Section, with report of the Advisor; use of radar in Traffic Law Enforcement, Radar Enforcement and Highway Patrol Needs—as well as various other Committee reports and proceedings.

Orders may be addressed to International Association of Chiefs of Police, 618 Mills Building, Pennsylvania Avenue at 17th Street, N. W., Washington 6, D. C.

Caterpillar Co. Makes New Safety Film

A challenging and dramatic new film on highway safety, "The Perfect Crime," has just been released by Caterpillar Tractor Co., Peoria, Ill., through its local dealers.

The 20½-minute, sound-color film is presented by Caterpillar with the cooperation of the National Safety Council's Construction Section and members of the Associated General Contractors of America. The film was produced by Calvin Company of Kansas City, Mo.

Newest in the Caterpillar series, "The Perfect Crime" follows "The Gamblers" which vividly emphasizes the value of safety in operation of construction equipment. A Golden Reel Festival winner, "The Gamblers" has been enthusiastically received throughout the construction industry.

"Message is so universal the film will be used far beyond the construction field," said an East Coast insurance company. "Viewed by almost every staff organization in our system," reported a West Coast railroad. "Narrated in the language of the construction man," said contractors all over.

At least one life already has been saved by "The Gamblers" and countless other persons have avoided painful accidents as a result of having seen the film.

"The Perfect Crime" is expected to have the same two-fisted value.

Ned H. Dearborn, president of the National Safety Council, said; "The National Safety Council recognizes fully the nation's requirements for better highways as a means of helping reduce the auto death toll. 'The Perfect Crime' presents this need dramatically and with unusual effectiveness."

"Anyone interested in highways and highway safety will want to see 'The Perfect Crime'," said William G. Hawkins, chairman of the NSC and AGC joint visual aids committee, after the premier at the NSC Congress in October at Chicago.

"The Perfect Crime" opens with a double murder in a $14 robbery. Public indignation is aroused and the murderer is rapidly apprehended. Then the narrator deftly draws the comparison with another crime—murder on the highways—and cites an apathetic public for its indifference to this tragedy.

Motorists are admonished in "The Perfect Crime," but not necessarily for their driving habits. The viewer is not told he is responsible for the maiming and murder, but there is no question that there is a responsibility and the viewer can accept or reject the blame.

This responsibility is for the vote that provides legislation which will give the motorist a modern, safe highway system and alert public officials.

Building the viewer up to a point where he is actually disturbed at what is being said about this responsibility, the film has a unique ending, creating a lasting impression that there's more to it than just "driver responsibility."

Showings of "The Perfect Crime" which is cleared for television, may be arranged with the nearest Caterpillar Dealer or by writing Sales Promotion Department, Caterpillar Tractor Co., Peoria 8, Ill.

Consultation Service In Applied Mathematics Offered

Mathematical Computing Service, 67-24 211th Street, Bayside 64, New York, specializes in performing services for industries desiring engineering calculations, charts and nomographs of a high degree of complexity, and the treatment of related mathematical problems in the field of civil engineering. An important function of the service is the mathematical formulation and complete problem solution from given physical data. The organization's staff consists of consultants holding Doctorate Degrees who are qualified to treat problems in applied mathematics related to the physical sciences.

ON THE SHELF

Compiled by
Mrs. Kathryn Cassidy, Librarian
Yale Bureau of Highway Traffic

The publications herewith listed are not available for distribution by the Bureau or the Institute. Inquiries should be directed to the agency listed as publishing the material.

Automotive Safety Foundation.

A Plan or Highway Classification in Maine: An Engineering Report to the State Highway Commission. The Foundation. 1952. 48 pp.

The recommendations and suggestions contained in this report are designed to provide the basis or long-range improvement of highway transportation in all areas of the state and in each class of roads and streets.

Beaver Valley, Pennsylvania. State Department of Highways. Planning and Traffic Division.

Beaver Valley Traffic Survey. The Department. 1952. Variously paged.

Beaver Valley, as referred to in this report, includes the three adjacent boroughs of Rochester, Monaca and Aliquippa. The data were based on 58,594 external (roadside) interviews and 6,519 internal (downtown street) interviews. The interviews covered an average weekday of July and August, 1951.

Bristol, Tennessee. State Highway Department. Division of Traffic and Finance Studies.

Comparative Analysis and Recommendations; Model Traffic Ordinance and the Traffic Ordinances of Bristol, Virginia-Tennessee. The Department. 1952. 149 pp.

Supplementary to the "Traffic Survey Report, 1950" and concerning the revisions necessary to bring these ordinances into conformity for better traffic control.

Mansfield, Ohio. State Department of Highways. Bureau of Planning and Programming. Highway Planning Survey.

Traffic Survey Report of Metropolitan Mansfield, Ohio, 1952. The Department, in cooperation with the City of Mansfield, Ohio, Richland County, Ohio and the U. S. Bureau of Public Roads. 1953. 69 pp.

Contains: Volume Counts; the Origin-Destination Survey; Screen-Line Check; Desire Line Maps.

Memphis, Tennessee. State Highway Department. Division of Traffic and Finance Studies.

A Parking Study of the Memphis, Tennessee Central Business District. The Department. 1952. Variously paged.

The survey is a cooperative project conducted jointly by the Department of Highways and Public Works and the U. S. Bureau of Public Roads. It was conducted during the summer of 1950 and was concerned only with parking activities in the C. B. D. on weekdays between 8:00 A.M. and 6:00 P.M. The purpose of this study was to determine the parking habits and requirements of motorists who go to the C.B.D. to shop, work or for business or pleasure and to obtain a measurement of the adequacy of the existing parking facilities that serve these motorists.

Moore, R. L.

Pedestrian Choice and Judgment. Reprinted from The Advancement of Science, 1953, 9, (36), 395-404.

An attempt to find the conditions where the risk of road accidents is greatest to pedestrians, and by studying the factors which influence choice and judgment to help the pedestrian form safer patterns of behavior.

Morgantown, West Virginia. State Road Commission Planning Division.

Traffic Survey Report of the Business Section. The Commission, 1953. 28 pp.

The purpose of the survey was to furnish data upon which to base action by the State Road Commission upon requests by the City for approval of the continuance of present traffic control devices, and installation of certain new devices. In addition, the report contains an analysis of the traffic capacities of the streets and recommends remedial action.

Nelson, James C.

Financing North Dakota's Highways, Roads and Streets. The Legislative Research Committee of the State of North Dakota. 1952. 352 pp. (Assisted by William H. Dodge.)

This report assembles historical, financial and tax data pertaining to the problem of financing any one of the long-range programs of highway, road and street improvement recommended by the companion report "An Engineering Study of North Dakota's Roads and Streets."

Olympia, Washington. Department of Highways (state). Traffic Engineering Division.

A Study of Vehicle Traffic and Business Trends "Before" and "After" One-Way Streets in Olympia, Washington. The Department. 1952. 26 pp.

This study of vehicle traffic and business trends in Olympia was undertaken to determine the effect of one-way street operation upon the economic and social activities of the urban area.

Paterson, New Jersey. Planning Board.

Future Land Use; a Section of the Master Reference Plan for Paterson—Part One: Economic Background and Residence. The Board, 1952. 31 pp.

The first of a series of reports which will constitute the tentative draft of the Master Reference Plan for the future development of the City.

Philadelphia, Pennsylvania. Planning Commission.

Capital Program; Public Improvements, 1953-1958. The Commission, 1952. 159 pp.

This publication presents the second Capital Program prepared for the City of Philadelphia and embodies a carefully thought-out policy designed to effect economies in the financing of public improvements estimated to cost $388,324,415.

(Continued on page 130)

Membership Applications

The following applications have been received since the list of applicants published last month.

APPLICATIONS FOR TRANSFER

BRITTON, George R.
Head Research Engineer
Pennsylvania Department of Highways
Harrisburg, Pennsylvania
November 19, 1954 for MEMBER grade

GREER, Maurice V.
Supervising Traffic Engineer
Texas Highway Department
Austin 14, Texas
November 22, 1954 for MEMBER grade

HENSLEY, Marble J.
Traffic Engineer
City of Chattanooga
Chattanooga, Tennessee
November 22, 1954 for MEMBER grade

HUTCHISON, Alexander L.
District Traffic Engineer
State of California, Division of Highways
Los Angeles 12, California
November 12, 1954 for MEMBER grade

MAIER, Eugene
Director, Dept. of Traffic & Transportation
Houston 2, Texas
November 17, 1954 for MEMBER grade

McREYNOLDS, Marshall B.
Vice-President & General Manager
Traffic Engineers Supply Corporation
Richmond, Virginia
November 3, 1954 for ASSOCIATE grade

RICE, Joseph F.
Senior Traffic Engineer
Kentucky Department of Highways
Frankfort, Kentucky
November 22, 1954 for ASSOCIATE grade

NEW APPLICATIONS

AUSTIN, Malcolm E.
Traffic and Planning Engineer
Clarkeson Engineering Co., Inc.
Boston, Massachusetts
November 9, 1954 for ASSOCIATE grade

BACKHOUSE, William O.
Town & Regional Planning Consultant
Johannesburg, South Africa
October 25, 1954 for MEMBER grade

BAYLEY, John M.
Traffic Engineering Assistant
Melbourne City Council
Melbourne, Victoria, Australia
November 17, 1954 for JUNIOR grade

BIDELL, William
Design Engineer
Ontario Department of Highways
Toronto, Ontario, Canada
November 17, 1954 for ASSOCIATE grade

CARPER, Walter G., Jr.
Research Engineer
Pennsylvania Department of Highways
Harrisburg, Pennsylvania
November 18, 1954 for ASSOCIATE grade

COLEMAN, Robert R.
Assistant Traffic Engineer
Pennsylvania Department of Highways
Harrisburg, Pennsylvania
November 8, 1954 for ASSOCIATE grade

WHITE, William S.
Traffic Planning Assistant
City of Richmond, Dept. of Public Safety
Richmond, Virginia
October 29, 1954 for ASSOCIATE grade

Letter to the Editor

Sir: I wish to compliment you on the way you handled the article on the "scramble" system in the August issue of TRAFFIC ENGINEERING magazine. The thing we would like understood most is that we do not approve the "scramble" system for general use, and it is important that certain warrants be followed or the "scramble" system will boomerang on traffic engineers or others who may try this installation. We have heard from several sources that some cities have tried the "scramble" system and report a failure. If you will permit a suggestion, it is believed that a follow-up article giving the story of some failure of the system and the reasons for such failure would be in order. It is my understanding that several cities back east have tried the system with poor success. No doubt you could find out other locations where the system has failed.

I wish to thank you again for the opportunity of submitting an article for the magazine.

ROBERT D. DIER
City Traffic Engineer
Long Beach, California

New Appointments

Mullen and Walbert Join Wilbur Smith Associates

Wilbur Smith and Associates of New Haven, Connecticut, recently announced the appointment of two new engineers to its staff.

Claree S. Mullen, who retired last July as Deputy Commissioner and Chief Engineer for the State Highway Department of Virginia, took charge of the consultant firm's Richmond, Virginia, office on September 15. Besides the Main Office in New Haven, the firm also has a branch office in Columbia, South Carolina.

Mullen served the Virginia Highway Department for almost 46 years. Born in Petersburg, Virginia, August 14, 1883, he joined the state agency November 1, 1908, soon after his graduation from Virginia Military Institute and was one of the first engineers employed by that department which was organized in 1906. Rising through the rank from his first position as Construction Inspector, he served as acting Highway Commissioner in 1923. When the office of Chief Engineer was created in 1924, Mullen was given the position and served in that capacity until his retirement this year.

In the fall of 1951 the Board of Award, comprised of a single representative from AASHO, ARBA, and the Highway Research Board, selected Mr. Mullen to receive the 1951 George S. Bartlett Award, conferred annually upon an individual who has made an outstanding contribution to highway progress. For the first time, a second similar award went posthumously to the late Roy W. Crum, long Director of the Highway Research Board.

Appointment of Thomas E. Walbert (Mem., ITE), formerly Traffic Engineer for the E. I. DuPont deNemours Co. Savannah River Plant beng constructed for the A.E.C., as Associate Traffic Engineer, was confirmed also by the New Haven firm. Born in Batesville, Arkansts, July 17, 1912, Walbert received his degree in Transportation Engineering from the University of Michigan in 1936. After four years' work with the Arkansas State Highway Commission he entered the Yale Bureau, receiving his Certificate in 1941, following which he was employed by the Traffic & Planning Division of the Michigan Highway Department. In December, 1944, he was employed as a Traffic Engineer by the U. S. Army Transportation Corps and located in the European theatre.

(Continued on page 130)

Oops! Our Colorblindness Shows

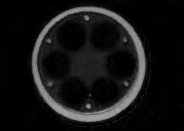
Editor, Traffic Engineering
Sir:

Our ad wasn't amusing, but quite confusing
The way it appeared in November
You see we detected, it should be corrected
Here's what you should do in December.
Please make it red, where it's yellow instead,
So your readers will know we're all right.
Don't change the white, 'cause like Stimsonite
It's best for seeing by day or by night.
If you'd be so kind, I hope you don't mind
Would you send all my bosses a letter.
Explain the mistake and the steps you will take,
To help save my job please, you'd better.

J. A. LONG
Advertising Department
AGA Division of Elastic Stop Nut Corporation of America

Our sincere apologies for having reversed the color plates last month when the A'G'A ad shown on the opposite page was printed. Obviously, the error occurred in our pressroom as such abuse of color standards would never have been approved by the experienced sign men at A'G'A. Although A'G'A has been wonderful about the matter, having already excused our "goof," we still want to publicly extend our sincere apologies.—EDITOR.

STIMSONITE SIGNS for every traffic need!



STIMSONITE reflectors

Even the smallest STIMSONITE signal is quickly and easily identified by motorists . . . despite glare from oncoming headlights.

from these tiny delineators . . .

to the largest of traffic signs . . .

Workmen erecting the largest reflectorized traffic sign on the New York State Thruway. This sign is legible from more than a third of a mile.

show up better from all angles

Moderate first cost . . . low maintenance cost . . . long life . permanently sealed reflectors . . . more intense return beam . . . effective, wet or dry.

Radar speed signs on Virginia state highways.

Directional signs on Florida state roads.

Easy-to-use STIMSONITE embossed, cut-out letters eliminate the need for costly sign production equipment.

STIMSONITE® *for* *Seeability* / *Readability* / *Durability*

AGA DIVISION

ELASTIC STOP NUT CORPORATION OF AMERICA

1027 NEWARK AVENUE, ELIZABETH 3, NEW JERSEY

TWO for the price of ONE!

"The New York" One Way* arrow (type OW-10) has the legend on both sides and with its special punching may be mounted in numerous ways. Because this sign is immediately seen from either side, you mount only one in place of two . . . saving time and money. Buy 26 or more for

only 3.25 each

1-12 $3.75 13-25 $3.50

"U" Posts of highest quality carbon steel are always in stock.

*Other legends available - - - Write for complete details.

MUNICIPAL STREET SIGN CO., Inc.
773-7 Meeker Ave., B'klyn, N. Y.

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William Gennaro Company, New York, New York

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Michener and O'Connor, Inc., Harrisburg, Pennsylvania

STREETER-AMET COMPANY 118
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VEEDER-ROOT, INC. ..... Inside Front Cover
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WALD INDUSTRIES, INC. 116
Michener and O'Connor, Inc., Harrisburg, Pennsylvania

ON THE SHELF

(Continued from page 127)

Smeed, R. J.

Some Factors Affecting Visibility from a Driver's Seat and Their Effect on Road Safety. Reprinted from The British Journal of Physiological Optics, June 1953, 10 (2), 63-85.

The ability to see objects in the road ahead is affected by many factors in addition to the efficiency of the eyes: fog, darkness, obstructions in the road ahead, on curves by trees and buildings at the side of the road, height of the driver above the bonnet of the vehicle, ability to see sideways, and rear view mirror.

Smeed, R. J.

Some Factors Influencing the Road Behaviour of Vehicle Drivers. Reprinted from The Advancement of Science, 1953, 9 (36), 395-404.

The factors discussed include: legal restrictions, sign observance, presence of police; clear instructions, propaganda and driver attitude.

MULLEN AND WALBERT JOIN WILBUR SMITH ASSOCIATES

(Continued from page 128)

Upon his return he prepared "The Plan for Traffic" for the city of Little Rock, Arkansas, as its Traffic Consultant. In October, 1946, he became Traffic Engineer for the Georgia Highway Department, where he remained until joining the DuPont Company.

Mrs. Walbert and their two children have already joined him in the home the Walberts bought in Hamden (suburb of New Haven).

CONFUSION AND CLARIFICATION — WHAT GENERAL CLAY ACTUALLY SAID

(Continued from page 122)

additional $54 billion that must be raised to make the $101 billion program an actuality.

The Clay Committee's report to the President expected at New Year's will discuss all phases of the $101 billion proposal, but will give financing plans for only the $24 billion Federal share.

How that $24 billion might be financed also has been outlined by General Clay.

He said a separate commission would be set up to issue revenue bonds under its own name. These would be secured by revenues from the Federal gasoline tax.

General Clay explained this tax brings in a billion dollars a year and that the Federal Government, under the proposed program, would allocate $550 million annually to the states for construction of primary and secondary roads.

He said the remainder of the funds, which he anticipated will increase over the years because of heavier gas and petroleum consumption, would support the revenue bond issue over a thirty-year period, figured on a three per cent interest rate.

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